DOCUMENT RESUME

ED 046 650 RE 003 227

TITLE	Visual Acuity of Children: United States.
INSTITUTION	Health Services and Mental Health Administration (DHEW), Bethesda, Md.
REPORT NO	PHS-Pub-No-1000-Ser-11-No-101
PUB DATE	Feb 70
NOTE	42p.
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 ($0.45)
EDRS PRICE	EDRS Price MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	*Children, *National Surveys, *Research, *Screening Tests, Vision Tests, *Visual Acuity

ABSTRACT

National estimates based on the findings from the Health Examination Survey in 1963 to 1965 of uncorrected monocular and binocular visual-acuity levels of children were studied. A nationwide sample of 7,417 children was selected to represent the approximately 24 million noninstitutionalized American children between ages 6 and 11 years. Testing was done with the Master Ortho-Rater, a commercial instrument, on all children who could read letters. Those who could not read were tested using Landolt ring charts. Nearly three-fourths of the subjects were found to have at least "normal" (20/20 or better) binocular distance vision. The proportion with defective binocular distance vision showed a remarkably consistent increase with age. At age 6, less than 1 percent tested no better than 20/100, while by age 11, the percentage had increased to nearly 8. Boys were found to have significantly better binocular visual acuity at both distance and near than girls. Binocular vision tended to exceed monocular vision at both distance and near. Finally, closer agreement was found between binocular and better monocular acuity than between the acuities for the two eyes. Tables, figures, and references are given. (Author/DE)

ED046650
RE003 227
VITAL and HEALTH STATISTICS
DATA FROM THE NATIONAL HEALTH SURVEY

NATIONAL CENTER For HEALTH STATISTICS
Series 11 Number 101

Visual Acuity of Children

United States

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration

Series 11 reports present findings from the National Health Examination Survey which obtains data through direct examination, tests, and measurements of samples of the U.S. population. The reports published to date (Nos. 1 through 34) have related to the adult program. Additional reports concerning this group will be forthcoming and will be numbered consecutively, 35, etc. The present report represents the first of a large number of reports of findings from the children and youth programs, Cycles II and III of the Health Examination Survey. These reports, emanating from the same survey mechanism, will be published in Series 11 but will be numbered consecutively beginning with 101, the present report. It is hoped this will facilitate the efforts to provide users with all of the data and only the data in which they are interested.

Public Health Service Publication No. 1000-Series 11-No. 101

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ED0 46650

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VITAL and HEALTH STATISTICS
DATA FROM THE NATIONAL HEALTH SURVEY

Visual Acuity of Children

United States

Vision testing methods with uncorrected monocular and binocular visual acuity findings by age and sex among children 6-11 years of age.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration

Washington, D.C. February 1970

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COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

Public Health Service Publication No. 1000-Series 11-No. 101

Library of Congress Catalog Card Number 70-602408

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THIS REPORT CONTAINS national estimates based on findings from the Health Examination Survey in 1963-65 on uncorrected monocular and binocular visual acuity levels of children 6-11 years of age.

For this part of the survey a nationwide probability sample of 7,417 children was selected to represent the roughly 24 million noninstitutionalized children 6-11 years of age in the United States. Of these, 7,119 or 96 percent were examined.

Monocular and binocular central visual acuity at distance and near were measured without cycloplegics for each examinee as part of the standardized examination. Testing with a commercial instrument at 12 levels was done without glasses for all children who could read letters. Those who could not read letters were tested on approximately comparable Landolt ring charts.

Nearly three-fourths of these children have at least "normal" (20/20 or better vision in Snellen notation) binocular distance vision without correction. The proportion reaching similar levels at near is only slightly less.

The proportion with defective binocular distance vision is small but shows a remarkably consistent increase with age, year by year, for both boys and girls.

Boys were found to have slightly but significantly better binocular visual acuity at both distance and near than girls.

Binocular vision tends to exceed the better monocular vision which in turn generally tends to be better than that for either eye alone.

Closer agreement was found between binocular and better monocular acuity than between the acuities for the two eyes. The degree of association between distance and near acuity was found to be highly significant, but of a lower order than for the other measures at distance only.

SYMBOLS

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VISUAL ACUITY OF CHILDREN

Jean Roberts and Kenneth R. Duyan, *Division of Health Examination Statistics*

INTRODUCTION

This report presents uncorrected monocular and binocular visual acuity levels of children 6-11 years of age in the noninstitutional population of the United States as estimated from the Health Examination Survey findings of 1963-65.

The Health Examination Survey from which these data derive is one of the major programs of the National Center for Health Statistics, authorized under the National Health Survey Act of 1956 by the 84th Congress as a continuing Public Health Service activity to determine the health status of the population.

Three different programs are used in carrying out the National Health Survey.[1] One of these—the Health Interview Survey—is concerned principally with the impact of illness and disability upon the lives and actions of people. It collects information from samples of people by household interview. A second—the Health Records Survey—consists of followback studies based on vital records, institutional surveys to establish sampling frames and provide data, and surveys based on hospital records. The Health Examination Survey is the third major program.

Data are collected in the Health Examination Survey by direct physical examinations, tests, and measurements performed on the sample populations under study. This method provides the best way to obtain actual diagnostic data on the prevalence of certain medically defined illnesses. It is the only way to secure information on unrecognized and undiagnosed conditions and on a variety of physical, physiological, and psychological measures within the population. It also provides demographic and socioeconomic data on the sample population under study.

The Health Examination Survey is conducted as a series of separate programs referred to as "cycles." Each cycle is limited to some specific segment of the U.S. population and to certain specified aspects of the health of that population. Data in the first cycle were obtained on the prevalence of certain chronic diseases and on the distribution of various physical and physiological measurements and other characteristics in a defined adult population, as previously described.[2,3]

For the second cycle, on which this report is based, a probability sample of the Nation's noninstitutionalized children 6-11 years of age were selected and examined. The examination focused primarily on health factors related to growth and development. It included examinations by a pediatrician and a dentist, tests administered by a psychologist, and a variety of tests and measurements by a technician. This survey plan, sample design, examination content, and operation have been described previously.[4]

Field collection operations for this cycle were started in July 1963 and completed in December 1965. Out of the 7,417 children selected in the sample, 7,119 or 96 percent were examined. This national sample is representative of the roughly 24 million noninstitutionalized children 6-11 years of age in the United States.

Each child, during a single visit, was given a standardized examination by the examining team in the mobile units specially designed for use in the survey. Prior to the examination, information

was obtained from the parent of the child consisting of demographic and socioeconomic data on household members as well as medical history, behavioral and related data on the child to be examined. Ancillary data for the child on grade placement, teacher's ratings of his behavior and adjustment, and health problems of the child known to the teacher were requested from the school he attended. Birth certificates were obtained for verification of the child's age and facts relating to the child at birth.

Statistical notes on the survey design, reliability of the data, and sampling and measurement error are shown in appendix I.

VISION EXAMINATION

The vision examination consisted of tests to detect and classify color vision deficiencies, both monocular and binocular tests to measure the level of central visual acuity at distance and near, tests for lateral phoria at distance and near and for vertical phoria at distance, a test for bilateral accommodation at distance, and distance and near tests for binocularity. Except for color vision, tests were performed without glasses or other refractive lenses for those who normally wore them.

In addition, each child was given an eye examination by the survey staff pediatrician. This included a careful inspection of the eyes for evidence of styes, conjunctivitis, blepharitis, nystagmus, and ptosis as well as tests to detect the presence and type of strabismus.

This report is limited to the tests of monocular and binocular central visual acuity at distance and near. As indicated, all tests were done without correction.

The Testing Instruments

The need for consistent uniformity in testing in addition to space and time limitations were determining factors in the selection of a commercial instrument, the Master Ortho-rater, for the testing of visual acuity of children who could read letters. Since no target was available for testing the near vision of children who could not read and since difficulties were encountered during the pretest in using the distance Landolt ring slide in the enclosed instrument, special charts administered separately from the instrument at both distance and near were developed for use with illiterates to be tested in the survey.

Shown in figure 1, the Master Ortho-rater device consists of a viewing box and two illuminated slide holders with two sets of test slides mounted inside the metal case. Slides used to test distance vision are mounted on an illuminated drum located at the right side of the instrument; those used to test near vision, on an illuminated drum at the left. A spring switch holds each drum accurately at each possible position. Only the slide in focus is illuminated. Without changing the position of the head of the examinee, the viewing box is tipped up to a set position for distance viewing and down slightly into a set position for near. The instrument is also adjustable for differences in eye height (above the chinrest). Distance targets or slides are viewed at a distance of 26 feet simulated optically by means of convex lenses; near targets, at 13 inches.

This instrument permits rapid testing under controlled conditions of lighting and target distance from the examinee. The effective illumination on the target and the contrast between target letters and background were maintained within optimum limits for such tests.[5]

Selected targets developed by Dr. Louise Sloan of the Wilmer Eye Institute at Johns Hopkins University for the Armed Forces[6] were used in the Master Ortho-rater during the survey. These targets on the slides in the instrument consisted of lines of optotypes which were letters appropriately graded in size from one line to the next and arranged in decreasing size from the top to the bottom of the slide to test at 12 levels from ones corresponding to 20/12 to 20/400 (Snellen notation). These levels consisted of the equivalents of 20/12, 20/15, 20/17, 20/20, 20/25, 20/30, 20/40, 20/50, 20/70, 20/100, 20/200, and 20/400 at distance with the 12 corresponding equivalents at near. The 10 unserifed letters used were of nearly equal legibility and were arranged in random order—differing for each line, each eye, and for distance and near. As previously described, these letters met the recommendations of the Committee on Optics and Visual Physiology of the American Medical Association.[7,8] The letters followed the Snellen principle with their height as well as

Figure I. The vision testing.

their width being five times the width of the lines in the letters. The targets consisted of 10 letters per line arranged in groups of 5 each for testing from 20/12 to 20/200 and 3 letters at 20/400 (and their equivalents at near), as shown in appendix II.

The comparability between these letter slides and correspondingly sized slides of Landolt rings used in the Master Ortho-rater has been investigated.[9]

For testing nonreaders at distance, a special wall chart was developed for use in the survey. The target followed Landolt ring dimensions with appropriate sized optotypes, which were rings, and random symbol arrangement in five-symbol blocks from the corresponding Armed Forces plate. Contrast between background and symbols met the same specifications used in the letter targets. The chart was laminated with nonglare plastic. Test symbols arranged five to a line were graded in size from one line to the next for testing at a distance of 10 feet from the child at levels of 10/5.35, 10/7.15, 10/8.95, 10/10.7, 10/12.5, 10/14.3, 10/19.65, 10/25, 10/35.7, 10/50, and 10/100—corresponding approximately to distance levels of 20/10.7, 20/14.3, 20/17.9, 20/21.4, 20/25, 20/28.6, 20/39.3, 20/50, 20/71.4, 20/100, and 20/200.

The near chart for use at 14 inches for children who could not read letters was similarly adapted from one developed at the Wilmer Eye Clinic of Johns Hopkins University. The five-symbol lines on this chart were graded in size from one line to the next for testing at levels of 14/14, 14/17.5, 14/21, 14/28, 14/35, 14/42, 14/56, 14/70, 14/87.5, 14/112, and 14/140.

In all, 81 percent of the children were tested on letter targets and 19 percent on Landolt ring charts or cards. The proportion tested with Landolt rings ranged from 76 percent among those 6 years of age to 1 percent for the 11-year-old group as shown in table A.

With completely comparable size optotypes, Sloan et al.[9] have found a correlation of 0.90 at distance between letter targets of the type used in this survey and comparable Landolt ring slides, both used in the Master Ortho-rater. They further indicate that since this correlation is of approximately the same magnitude as that obtained between test and retest scores on the same target,[10] the two forms of acuity test may be considered essentially equivalent.

Table A. Proportion of children tested on Landolt ring charts, by age: Health Examination Survey, 1963-65

Age	Total	Boys	Girls
	Percent		
Total, 6-11 years-	18.9	19.7	18.0
6 years----------	75.9	78.9	72.6
7 years----------	27.6	29.7	25.3
8 years----------	7.3	6.9	7.7
9 years----------	2.9	3.0	2.7
10 years----------	1.9	1.2	2.6
11 years----------	1.1	1.1	1.1

It will be noted that the optotype sizes, for either symbol or letter, differ slightly for 7 of the 11 levels existing on both distance targets—they are identical at 20/200, 20/100, 20/50, and 20/25. Somewhat closer agreement was available on the near tests where 7 of the levels were of identical size—the levels equivalent to 20/200, 20/100, 20/50, 20/40, 20/30, 20/25, and 20/20.

When the distributions are combined as they are in tables 1-4 for distance, this will mean that the proportions may possibly be slightly higher than they would be if the targets had been completely comparable at 20/70, 20/20, and 20/17 and slightly lower at 20/40, 20/30, 20/15, and 20/12.

Testing Methods

The testing order of right eye, left eye, and binocular vision was maintained throughout the cycle. However, the sequence of near and distance tests was alternated for successive examinees. Testing order was randomized in this fashion to minimize any consistent bias for either test series due to fatigue, practice, or learning the target letters. Every effort was used to secure a maximum level of participation on the part of the child so that the measurements would be as accurate as possible. During the color test, which preceded the tests for visual acuity, it was possible to determine without embarrassing the child by asking whether or not he could read letters. For those who could not read, visual acuity was tested on the Landolt ring charts as previously indicated. For the very slow reader, it was also sometimes necessary to switch to the Landolt ring charts to lessen the impact of fatique and loss of interest on the child's performance, since with these charts the examiner had greater control over the reading pace.

For children who could read well enough to take the regular examination, the following test procedure was used. Each child was asked to read the line corresponding to an acuity level of 20/30 (or the equivalent at near). If the child was unable to do this with no more than the allowable number of errors to "pass," he was presented the line corresponding to an acuity comparable to 20/50. If the child again failed, he was started at the 20/400 line. The child read the lines of progressively smaller letters until he failed or completed the test.

In testing nonreaders and slow readers on the Landolt ring chart or card, the examiner began at the line with the largest rings (20/200 at distance or the equivalent at near). The child was asked to point in the direction of the "bite" in the ring. The examiner continued this procedure for the first ring on each line until one was missed. At that point the examiner went back to the previous line and asked the child to read (point in the direction of the "bite") each symbol on the entire line. The same was done for the line or lines above and below it, to be sure the correct acuity level was determined.

To "pass" or to be able to read at a particular level, no errors were allowed if the line contained three letters, one in lines of five symbols, and three in lines of 10 letters. The visual acuity level or "score" for an examinee was that which corresponded to the smallest letters or symbols that the child was able to read with no more than the allowable number of errors.

Quality Control

Vision tests were administered by the survey staff examining dentist because that member of the survey team had the time available for them. The effect of this was to have these tests done by a professional person who, once the necessary special training had been given, was highly adept at administering the tests. Each of the five dentists employed during the cycle was given training and practice in vision testing techniques to insure the consistency of test results. Further practice was obtained during the "dry runs" preceding the start of the regular examinations at each of the 40 areas in which the mobile Health Examination Centers were located.

A small-scale special study was conducted at District of Columbia Village, a home for dependent children, prior to the start of the cycle to determine the level of agreement between two of the examiners in the testing of children. A high level of agreement was found with more than three-fourths of the test results being identical or differing by no more than one acuity level.

Midway during the cycle, at the Chicago location, replicate examinations were given to 95 of the 284 children examined there. The first test was given by a different examiner than the second. Here a very high level of agreement was found on retest with nearly 90 percent of the tests differing by no more than one acuity level.

Test results appeared to remain consistent for the various examiners throughout the cycle. The proportion of children rated as having normal or better vision showed essentially no differences which might be attributable to the testers when the age and sex differences among examinees at the various locations were removed.

Testing equipment and illumination were checked periodically throughout the cycle to be sure they were in good working order and met the required standards.

FINDINGS

Binocular Distance Acuity

Nearly three-fourths (74.8 percent), or 19.5 million, of the children 6-11 years of age in the noninstitutional population of the United States have at least "normal" or better than "normal" binocular vision at distance without correction, as estimated from Health Examination Survey findings in 1963-65. Nearly half are able to read at levels of 20/17 through 20/12 or better and about 85 percent test at least 20/25 or better (table 1 and fig. 2).

The median unaided binocular acuity was at the 20/17.4 level. Hence, half of the children had better than "normal" vision since they were able

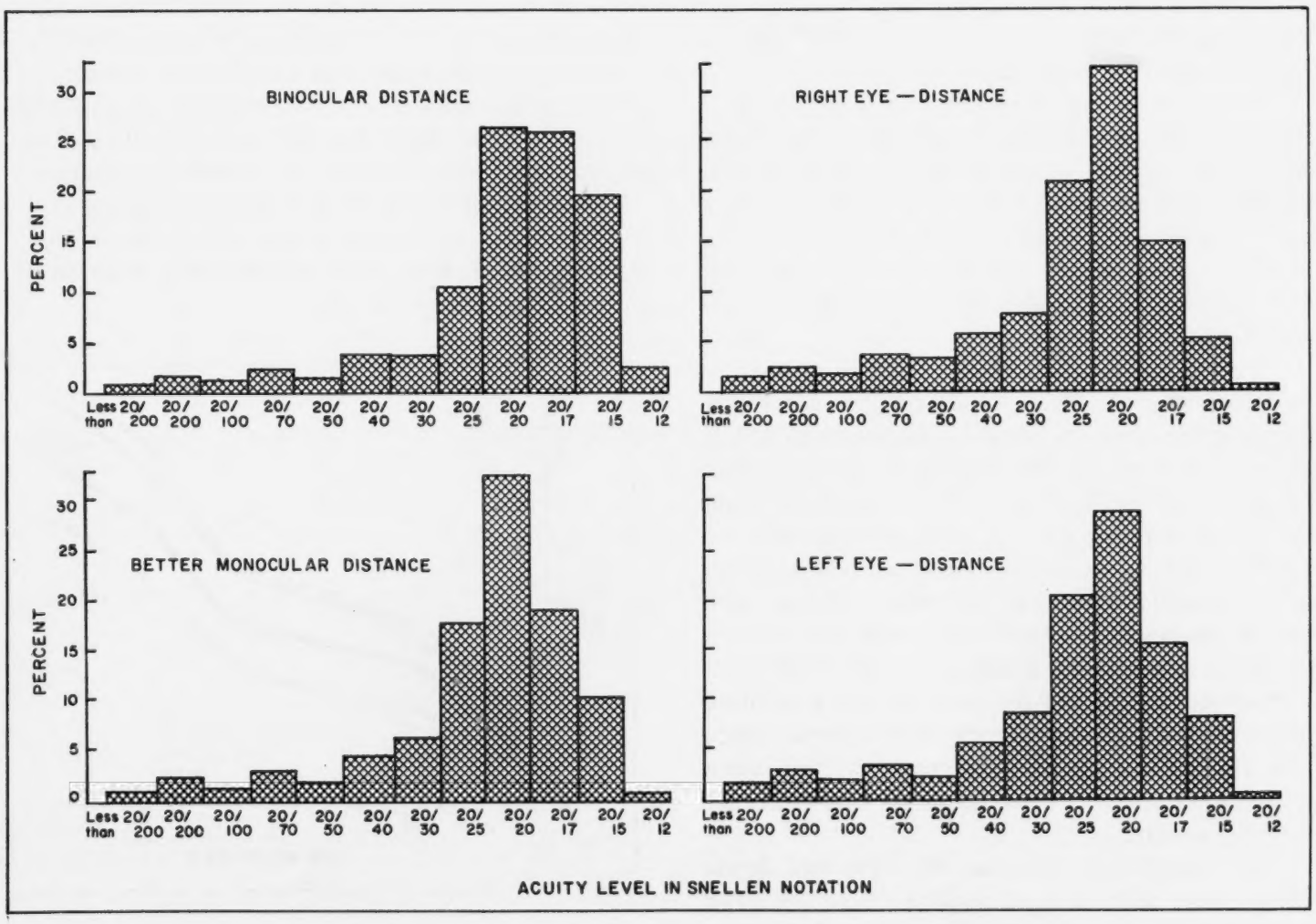

Figure 2. Percent of children, 6-11 years, reaching specified acuity levels for binocular and monocular distance vision.

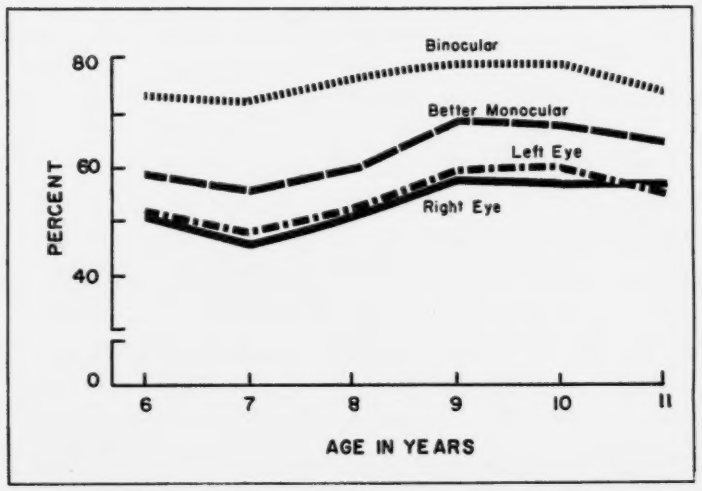

Figure 3. Percent of children, 6-11 years, reaching levels of 20/20 or better for binocular and monocular distance acuity, by age.

to read, at 20 feet, letters of a size that persons with what is generally considered to be "normal" vision could be expected to read at 17.4 feet, nearly 3 feet closer to the target.

About 9 percent have moderately defective binocular vision, reading at best no further than the 20/30, 20/40, or 20/50 levels, while an additional 6 percent would test at the 20/70 level or less. Roughly 4 percent (3.6 percent) have acuity no better than 20/100 while less than 1 percent (0.8 percent) are unable to read at the 20/200 level without correction.

The proportion of children unable to read at the 20/200 level is too small to give a reliable estimate for this segment of the population. Yet it can be said with a fair degree of certainty that the actual proportion of children probably does not exceed 1 percent. This group will include the legally blind, as well as those whose vision could be corrected to normal or near normal with lenses. However, neither the testing nor the examination procedures in this cycle were sufficient to provide the basis for making more precise estimates of the prevalence of blindness since they did not include assessment of the limitation of visual fields or the degree of correctibility of visual acuity.

No consistent pattern by age was found among those with at least normal vision, 20/20 or better fig. 3 and table 1). The proportions were the lowest among the youngest—6 and 7 year olds—and the oldest age groups. It ranged from 72 percent for the 7-year age group to 78 for the 9 year olds. However, the proportion with nearly normal or better vision (20/25 or better) showed a slight, consistent, downward trend with age, which was more pronounced among the older children, the proportions ranging from 88 percent at 6 years to 80 percent at 11 years.

At the lower end of the acuity scale a consistent increase in defective vision with age was found (fig. 4). For those testing no better than 20/70, the proportion ranged from 1 percent at 6 years to nearly 12 percent at 11 years of age. Or if the more seriously defective acuities are considered, the proportion ranges from less than 1 percent at age 6 to nearly 8 percent at 11 years at 20/100 or less and from less than 1 percent to nearly 6 percent at 20/200 or less.

Boys were found to have better binocular visual acuity at distance than girls. About 77 percent of the boys tested at least at the 20/20 level compared with 72 percent for girls. The difference in the proportion reaching at least the 20/25 level—86 percent for boys for 84 percent for girls—was less, but still differed more than would have been expected by chance in a sample of the design and size of that used for the survey. At the lower extremes of the acuity scale, the proportion of boys was significantly less than of girls (figs. 5 and 6; table 1).

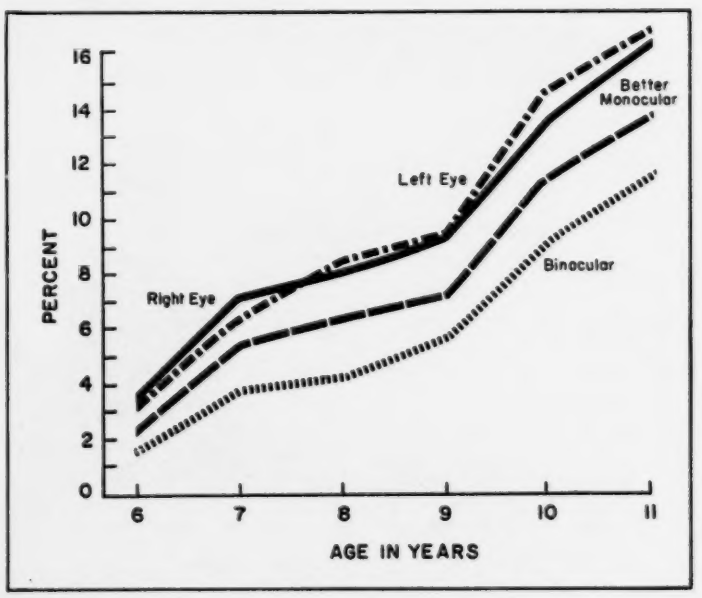

Figure 4. Percent of children, 6-11 years, testing no better than 20/70 for binocular and monocular distance acuity, by age.

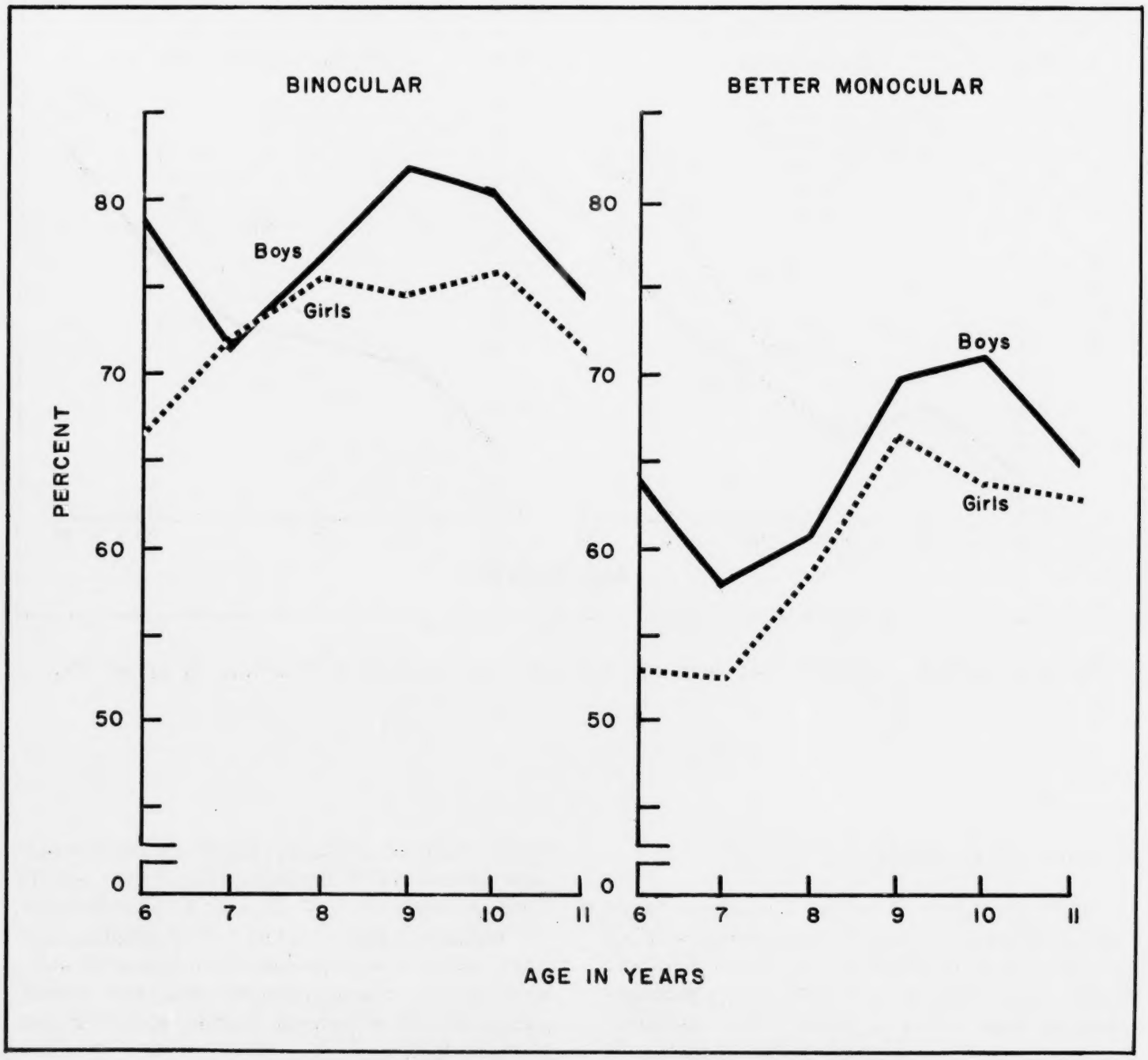

Figure 5. Percent of children, 6-11 years, with "normal" or better distance visual acuity (20/20 or better), by age and sex.

No really consistent trend by age was found among boys or girls with at least nearly "normal" (20/25 or better) or "normal" (20/20 or better) acuity. Among those with at least "normal" vision, the proportion for boys increased from ages 7 to 9 years then dropped consistently from 9 through 11 years. Girls showed an increase to age 8 years then a leveling off and drop only at 11 years (fig. 5).

At the lower end of the acuity scale a consistent increase with age in the proportion with unaided vision no better than 20/70 or 20/100, was found among girls. The trend with age also existed among boys except age 7 years (fig. 6).

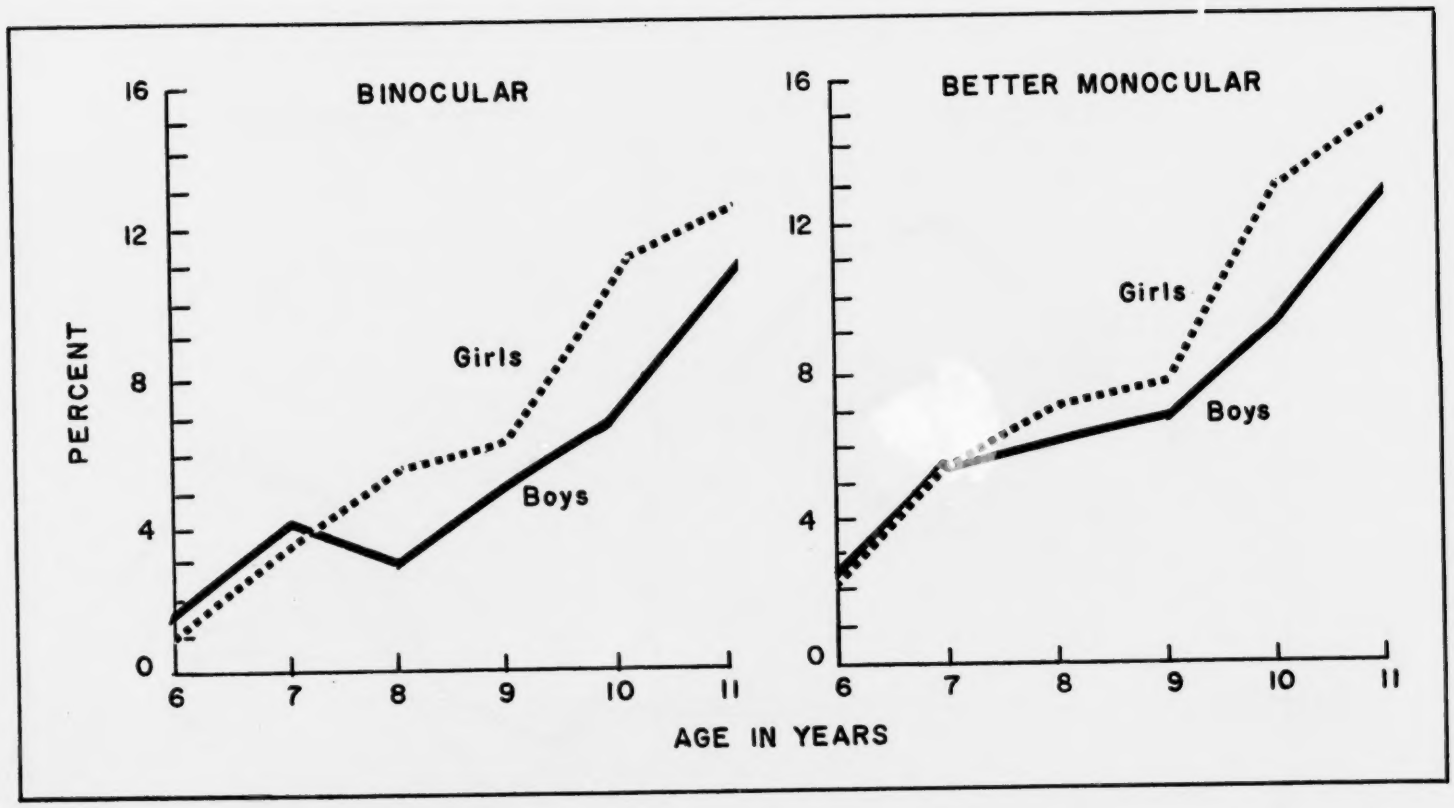

Figure 6. Percent of children, 6-11 years, with distance visual acuity of 20/70 or less, by age and sex.

Binocular Near Acuity

The distribution of "normal" or almost "normal" near binocular acuity among children of all ages was found to be similar to that at distance. Slightly less than three-fourths (72.6 percent) tested at least 14/14 or better, while 89.2 percent tested 14/17.5 or better (table 5 and fig. 7). These proportions do not differ significantly from those for similar levels at distance— 74.8 percent reaching the 20/20 level or better and 85.2 percent, the 20/25 level or better.

The proportion having moderately defective vision was about the same for near as for distance vision—9 percent. These are the percentages testing 14/21 through 14/35 at near and the similar levels of 20/30 through 20/50 at distance.

Relatively fewer children were found to have more severely defective near than distance vision, with 2 percent testing no better than 14/49 at near compared with 6 percent reading no better than 20/70 at distance.

By age there was a consistent increase in the proportion testing at least 14/14 or better at near from age 7 years on (fig. 8 and table 5), a trend not found at the similar levels of 20/20 or better for distance vision. At the 14/17.5 or better levels, with a slight exception for the 7-

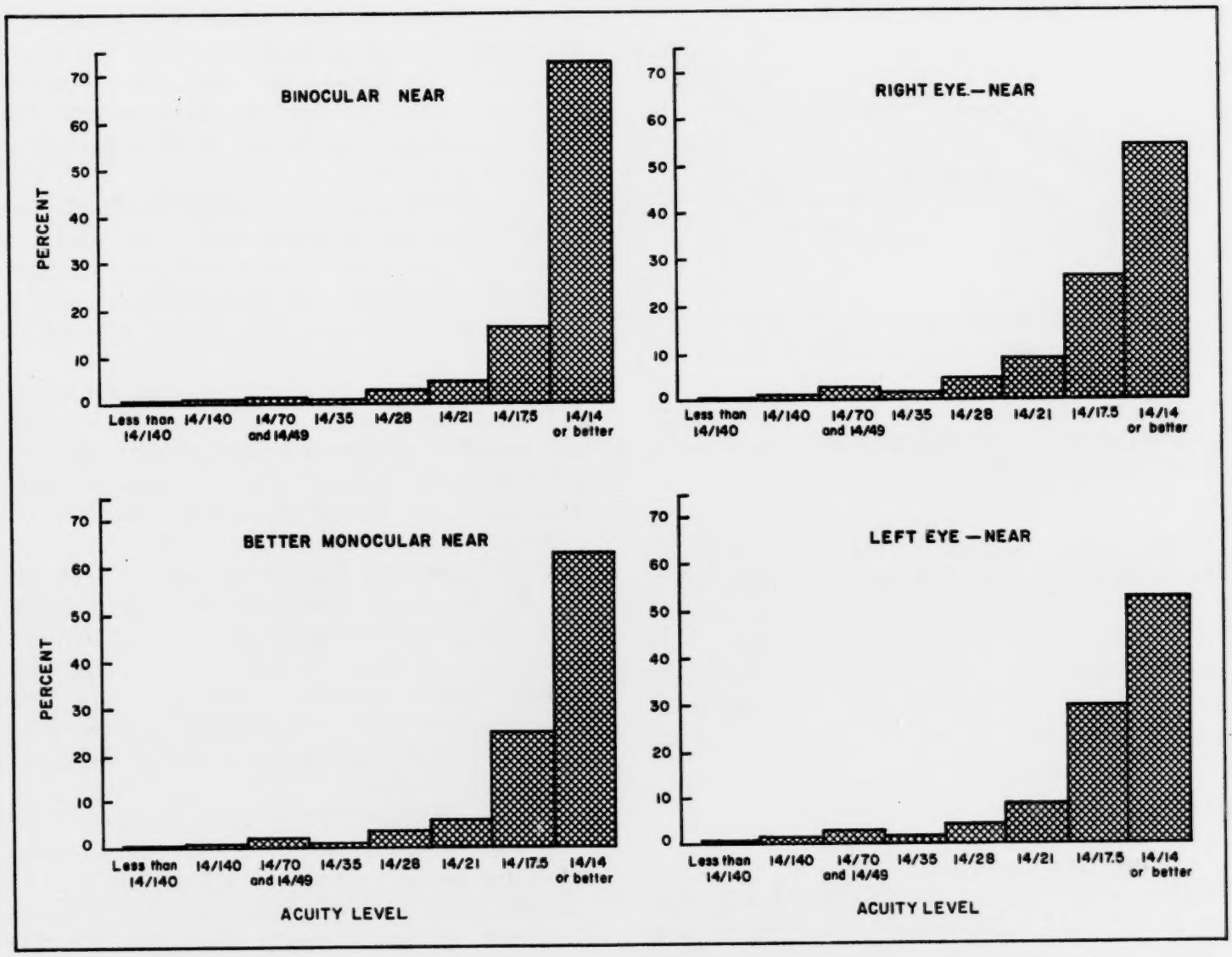

Figure 7. Percent of children, 6-11 years, reaching specified acuity levels for binocular and monocular near vision.

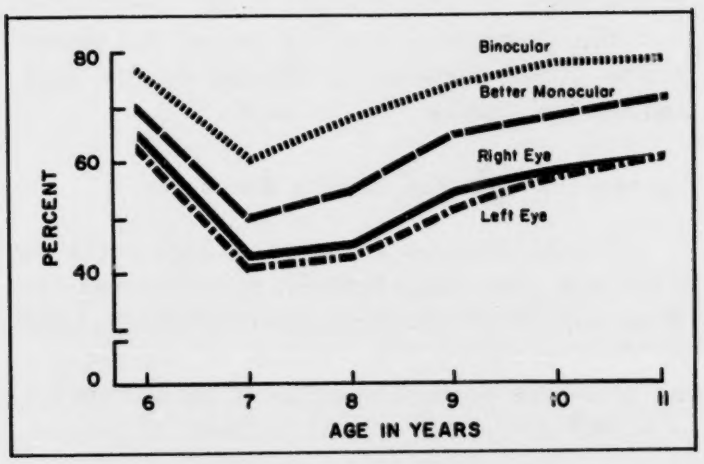

Figure 8. Percent of children, 6-11 years, reaching levels of 14/14 or better for binocular and monocular near acuity, by age.

year-old group, the proportions at each age were nearly all the same, with no slight, downward trend as existed for the similar levels at distance.

At the poorer end of the acuity scale, 14/49 or less, no trend by age was found—the proportions ranged from 1.5 percent at 6 years to 3.5 at 11 (fig. 9). This is in sharp contrast to the consistent increase of poorer distance acuity with age. From age 9 years on, the proportion was significantly lower than for the similar levels at distance—20/70 or less (fig. 4).

Boys were found to have slightly better binocular near visual acuity than girls, as was also found true for distance vision. The proportion of boys with "normal" or better vision reaching 14/14 or higher levels was significantly greater for boys (75.3 percent) than girls (69.8 percent).

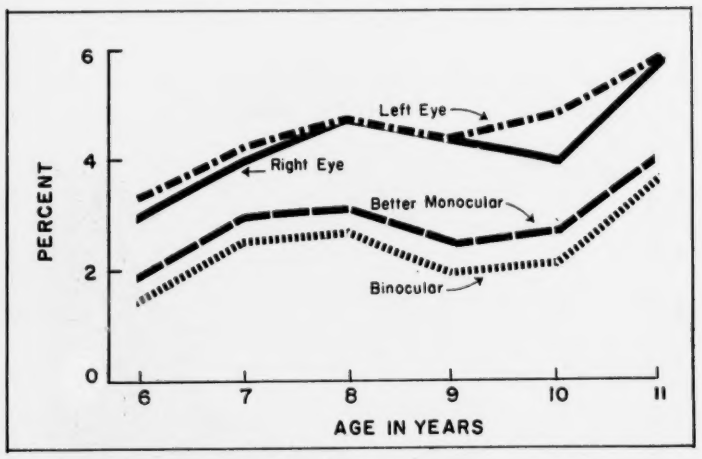

Figure 9. Percent of children, 6-11 years, testing no better than 14/49 for binocular and monocular near acuity, by age.

At the nearly "normal" 14/17.5 level or better, the differences were less, but still significant. However, the proportions of boys and girls testing at the poorer end of the acuity scale were similar—2 percent. No consistent pattern with age was found among boys or girls with better or poorer acuity (figs. 10 and 11).

Monocular Acuity

More than three-fifths (63 percent) of the children, or an estimated 16.4 million, had at least normal distance acuity in their better eye. Roughly 80 percent tested near normal or better at distance (20/25 or better). About 8 percent had poor acuities of 20/70 or less (table 2).

With age no really consistent trend in the proportion of children with better acuities at distance is found although there was a marked increase from 7 through 9 years in the proportion of children with at least normal distance acuity in the better eye. At the other end of the acuity scale, there is a steady increase with age in the proportion having poorer acuity (20/70 or less)—the rates range from 2.3 per 100 children at age 6 to 13.7 at age 11 years (figs. 3 and 4).

At near, as for distance, 63 percent have at least "normal" acuity in the better eye (14/14 or better) while a larger proportion than for distance—87.1 percent compared with 79.9—reach at least almost "normal" vision at near (14/17.5 or better). The proportion with poor near acuities—14/49 or less—is somewhat lower than for distance vision, 2.9 percent compared with 7.6 percent testing no higher than 20/70 in the better eye (tables 2 and 6).

By age the proportion testing 14/14 or higher in the better eye increases from 7 years on, but only from 7 through 9 years if those with near "normal" vision are also included. No trend with age for the proportion with poorer acuities is evident.

Binocular acuity tends to exceed the better monocular acuity which in turn generally exceeds the acuity for either eye. At distance about 12 percent more children test at least "normal" with their binocular acuity than with their better monocular acuity, while monocular acuity in either eye runs about 10 percent below the percentage for the better eye. If the near "normal" group is included, the differences drop to 5 percent between binocular and better monocular, and 6 percent between better monocular and either eye. The differences between these acuity measures is negligible at the lower end of the acuity range (tables 1-4).

At near the proportion testing at least "normal" is about 10 percent higher for binocular than for better monocular, which in turn is 10 percent above that for either eye. If the nearly "normal" group is also included, the difference in proportion reaching these levels is negligible between binocular and better monocular and drops to 6 percent between better monocular and that for either eye. Differences here are also negligible at the lower end of the acuity scale (tables 5-8).

The proportion reaching better and poorer acuity levels tends to be similar for the right and left eye (tables 3, 4, 7, and 8).

Agreement Between Acuity Measures

At both distance and near, a high order of agreement was found between the binocular and better monocular acuity scores of children (table B). The correlation of the scores at both distance and near was +0.94. The extent of agreement for boys and girls was similar. Over 75 percent

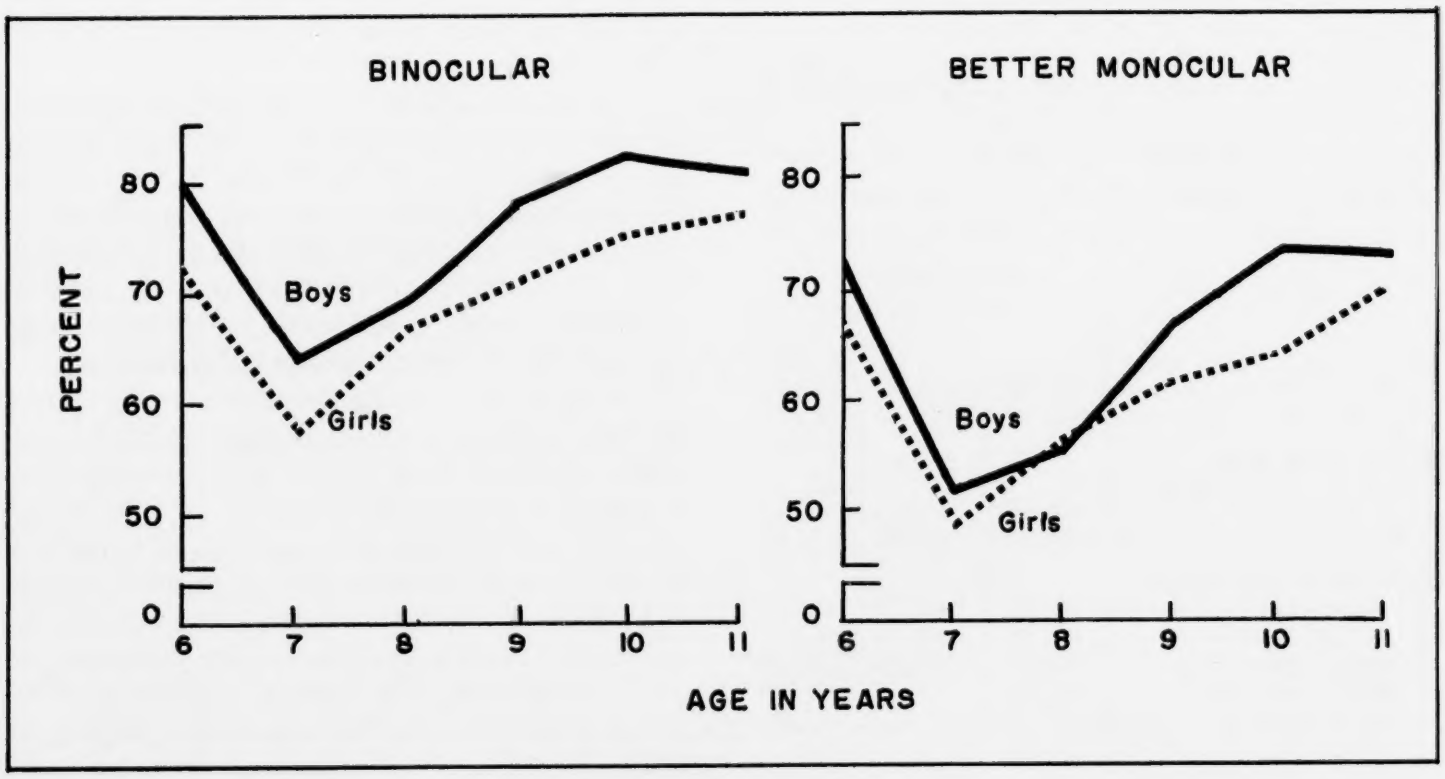

Figure 10. Percent of children, 6-11 years, with "normal" or better near visual acuity (14/14 or better), by age and sex.

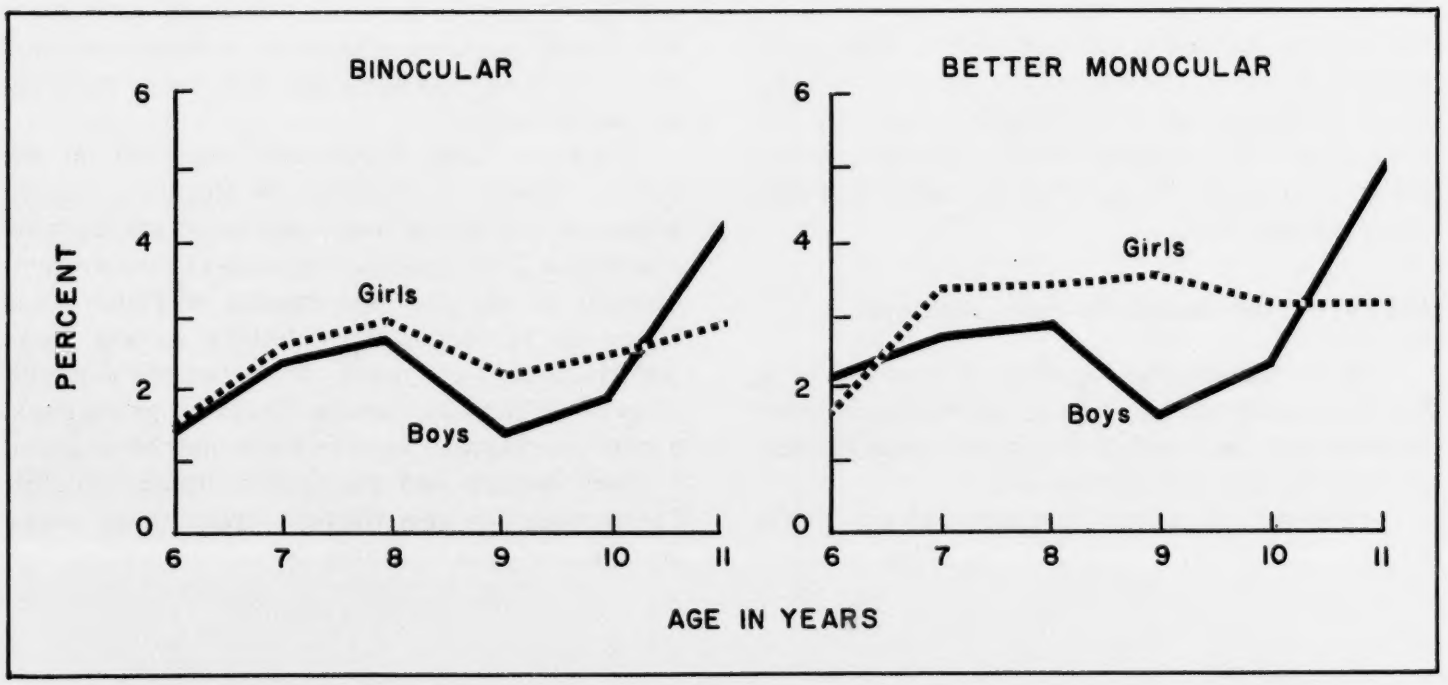

Figure 11. Percent of children, 6-11 years, with near acuity of 14/49 or less, by age and sex.

Table B. Correlation between various measures of visual acuity used in this study, by sex: Health Examination Survey, 1963-65

Acuity measures	Total	Boys	Girls
	Correlation coefficients		
Right and left eye:			
Distance	+0.78	+0.77	+0.80
Near	+0.57	+0.54	+0.59
Binocular and better monocular:			
Distance	+0.94	+0.94	+0.93
Near	+0.94	±0.95	+0.90
Distance and near:			
Binocular	+0.57	+0.57	+0.57
Better eye	+0.55	+0.54	+0.53
Right eye	+0.59	+0.58	+0.60
Left eye	+0.64	+0.68	+0.60

showed no difference in acuity level between better monocular and binocular vision.

The level of agreement between right and left eye acuities was also high, but of a markedly lower order of magnitude than that for binocular and better monocular vision. Better agreement was found at distance (+0.78) than at near (+0.57). No sex difference was found in this measure either.

Comparison of distance and near vision for the various measures of acuity shows a somewhat similar level of agreement for all four, ranging from +0.55 for better monocular acuity to +0.64 for the left eye. These levels are substantially lower than those for the right or left eye at distance but not near.

Acuity as Measured by Two Methods

In the foregoing sections of this report it has been assumed that the test results on the letter targets and the Landolt rings are roughly comparable for the levels discussed.

However, a further inspection of the distributions for better and poorer acuities obtained by both methods, as shown in tables C and 9-12, seems warranted.

It should be kept in mind that the optotypes at the level equivalent to 20/21.4 are slightly larger than those at 20/20 for a set distance but offsetting this is the fact that only one error was allowed on lines of five symbols compared with three errors allowed for passing lines of 10 letters. At the other levels the optotype sizes are equivalent on the corresponding targets.

Relatively more children were found to have at least normal acuity at distance on the Landolt rings (20/21.4) than on the approximately corresponding letter targets (20/20) at 6, 7, 8, and 10 years of age while the reverse was found at 11 years. At near, children throughout the age range did better on the Landolt rings. The reasons for these differences are not readily apparent. To some extent they may reflect differences in the children tested or the differences in testing technique in addition to the lack of complete comparability in the targets. Only at 6 years and to a slight extent at 7 years will these differences affect the overall distributions of acuities.

COMPARISON WITH OTHER STUDIES

Strictly comparable findings for visual acuity among children are not readily available from published reports. However, two large-scale studies among selected groups do give the proportion of children in this age range who have "normal" or better vision.

Slataper[11] and Weymouth[12] reported on the visual acuity of patients in Houston, Texas, based on refractive examinations which included more than 1,700 among children 6-11 years of age. Morgan et al.[13] gave the results of vision tests based on project-o-chart letters among some 400 children 7-11 years, from two of the public schools of Toronto, Canada. The latter group found a high correlation between tests and the project-o-chart letters and the Snellen letters (+0.96). Comparison of the findings from these three studies are shown in table D.

Table C. Proportion of children examined and found to have better and poorer acuities as determined by Landolt ring and letter test, by age: Health Examination Survey, 1963-65

Level	All ages, 6-11 years	6 years	7 years	8 years	9 years	10 years	11 years
	Percent						
Testing 20/20 or better on:							
Letter targets	74.8	67.7	70.6	75.3	78.0	77.7	73.2
Landolt rings	74.8	74.1	73.9	82.6	79.7	83.6	60.5
Testing 20/70 or poorer on:							
Letter targets	6.9	2.2	4.6	4.6	5.7	9.2	11.4
Landolt rings	1.4	1.2	1.8	0.0	2.2	0.0	11.8
Testing 14/14 or better on:							
Letter targets	69.1	42.5	51.0	66.6	73.9	77.9	78.8
Landolt rings	86.5	86.3	85.6	87.2	92.7	93.3	85.8
Testing 14/49 or poorer on:							
Letter targets	2.6	3.0	2.7	2.7	1.9	2.2	3.5
Landolt rings	1.3	1.0	1.9	2.4	0.0	0.0	6.5
Proportion examined with:							
Letter targets	81.1	24.1	72.4	92.7	97.1	98.1	98.9
Landolt rings	18.9	75.9	27.6	7.3	2.9	1.9	1.1

Table D. Proportion of children reaching visual acuity levels of 20/20 or better from selected studies, by age

Age	United States, 1963-65[1]	Private patients in Houston, Texas 1950[2]	School children in Toronto, Canada, 1952[3]
	Percentage		
6 years	51	44	---
7 years	46	52	72
8 years	51	56	84
9 years	58	61	83
10 years	58	69	80
11 years	56	75	78

[1]Study by the HES.

[2]Study by Slataper.[11]

[3]Study by Morgan et al.[13]

It might be expected that the findings of Morgan et al.[13] if their methods were similar, would be more nearly comparable to the present findings than those of Slataper. However, the data would not suggest this. Sufficient information is not available to determine whether these substantial differences result from the disparities in testing methods, the characteristics of the children, or both.

Only one available study investigated the relationship of distance and near acuity measures among children. Kephart[14] in his study of nearly 2,200 school children in grades three through 12 found a slightly, but not significantly, lower order of agreement than was found in the present study—+0.55 compared with +0.57. A greater difference might have been expected since he used the checkerboard targets from the Ortho-rater rather than those used in the present study.

SUMMARY

National estimates based on Health Examination Survey findings from a highly representative sample of children 6-11 years of age in the noninstitutional population of the United States show that:

1. Nearly three-fourths, or 19.5 million, of these children have at least "normal" or better than "normal" (20/20 or better) binocular distance vision without correction. The proportion reaching similar levels at near is only slightly less.

2. No consistent pattern of better visual acuity at distance was found with age; at near the proportion increased from 7 years on.

3. The proportion with defective binocular distance vision is small, but shows a remarkably consistent increase with age, year by year. At age 6, less than 1 percent tested no better than 20/100, while by age 11, the percentage had increased to nearly 8. This pattern prevails for both boys and girls and is seen at the various poorer acuity levels—no better than 20/70, 20/100, or 20/200. A similar trend with age is not found for poorer near vision.

4. Boys were found to have slightly but significantly better binocular visual acuity at both distance and near than girls.

5. Relatively more children were found to have poorer acuity at distance than near—nearly 6 percent did not read above the 20/70 level at distance compared with 2 percent reaching just to the similar level at near.

6. Binocular vision tended to exceed better monocular vision at both distance and near. Slightly more than 60 percent had "normal" or better monocular vision compared with about three-fourths for binocular acuity.

7. The acuity in either eye tends in general to be similar but somewhat less good than that for the better eye. The proportion testing at least normal is about 10 percent below that for better monocular vision.

8. Closer agreement was found between binocular and better monocular acuity than between the acuities for the two eyes. The degree of association between distance and near acuity was found to be highly significant but of a lower order than for the other measures at distance only.

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Table 1. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected binocular distance acuity, by sex and age: United States 1963-65

Sex and age	Acuity level											
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	Less than 20/200
	Percentage											
Both sexes												
All ages, 6-11 years	2.7	19.6	26.0	26.5	10.4	3.7	3.8	1.4	2.3	1.1	1.7	0.8
6 years	3.1	19.6	21.8	28.2	15.2	4.7	5.1	0.9	0.9	0.2	0.2	0.1
7 years	1.7	11.9	23.2	34.8	15.0	4.1	4.2	1.3	2.3	0.4	0.9	0.2
8 years	1.5	15.3	26.7	32.4	10.6	4.4	3.3	1.6	1.5	0.8	1.1	0.8
9 years	1.9	21.1	31.8	23.3	8.4	3.3	3.6	1.0	1.8	1.2	1.9	0.7
10 years	3.3	24.7	27.8	22.0	6.6	2.2	2.9	1.5	3.5	1.9	2.8	0.8
11 years	4.6	25.5	24.8	18.2	6.4	3.3	3.7	2.0	3.7	2.2	3.6	2.0
Boys												
All ages, 6-11 years	3.6	21.9	26.0	25.5	9.5	3.2	3.7	1.4	2.0	1.0	1.6	0.6
6 years	2.6	23.6	23.4	28.6	11.4	3.8	4.3	0.5	1.1	0.4	-	0.3
7 years	2.5	12.6	24.5	31.9	14.9	4.5	3.6	1.3	2.4	0.6	1.1	0.1
8 years	2.3	18.4	25.3	30.5	10.3	3.8	4.2	2.1	1.1	0.3	1.4	0.3
9 years	2.5	23.5	31.5	24.0	6.9	2.5	3.1	1.0	1.7	1.2	1.5	0.6
10 years	5.3	27.7	26.9	20.1	6.7	1.7	2.9	1.6	2.7	1.6	2.2	0.6
11 years	6.9	26.1	24.3	17.4	6.4	2.8	3.7	1.9	3.3	1.9	3.6	1.7
Girls												
All ages, 6-11 years	1.6	17.2	26.0	27.6	11.5	4.2	4.0	1.4	2.5	1.3	1.8	0.9
6 years	3.5	15.4	20.2	27.8	19.2	5.6	5.9	1.4	0.7	-	0.3	-
7 years	0.9	11.2	21.8	37.7	15.1	3.8	4.8	1.3	2.2	0.2	0.7	0.3
8 years	0.7	12.2	28.1	34.2	10.9	4.9	2.4	1.1	2.0	1.5	0.7	1.3
9 years	1.3	18.6	32.1	22.4	10.0	4.1	4.0	1.1	2.0	1.2	2.4	0.8
10 years	1.3	21.5	28.8	23.8	6.6	2.7	2.9	1.3	4.3	2.3	3.4	1.1
11 years	2.2	24.8	25.3	19.1	6.5	3.8	3.7	2.2	4.2	2.5	3.5	2.2
	Cumulative percentage											
Both sexes												
All ages, 6-11 years	2.7	22.3	48.3	74.8	85.2	88.9	92.7	94.1	96.4	97.5	99.2	100.0
6 years	3.1	22.7	44.5	72.7	87.9	92.6	97.7	98.6	99.5	99.7	99.9	100.0
7 years	1.7	13.6	36.8	71.6	86.6	90.7	94.9	96.2	98.5	98.9	99.8	100.0
8 years	1.5	16.8	43.5	75.9	86.5	90.9	94.2	95.8	97.3	98.1	99.2	100.0
9 years	1.9	23.0	54.8	78.1	86.5	89.8	93.4	94.4	96.2	97.4	99.3	100.0
10 years	3.3	28.0	55.8	77.8	84.4	86.6	89.5	91.0	94.5	96.4	99.2	100.0
11 years	4.6	30.1	54.9	73.1	79.5	82.8	86.5	88.5	92.2	94.4	98.0	100.0
Boys												
All ages, 6-11 years	3.6	25.5	51.5	77.0	86.5	89.7	93.4	94.8	96.8	97.8	99.4	100.0
6 years	2.6	26.2	49.6	78.2	89.6	93.4	97.7	98.2	99.3	99.7	99.7	100.0
7 years	2.5	15.1	39.6	71.5	86.4	90.9	94.5	95.8	98.2	98.8	99.9	100.0
8 years	2.3	20.7	46.0	76.5	86.8	90.6	94.8	96.9	98.0	98.3	99.7	100.0
9 years	2.5	26.0	57.5	81.5	88.4	90.9	94.0	95.0	96.7	97.9	99.4	100.0
10 years	5.3	33.0	59.9	80.0	86.7	88.4	91.3	92.9	95.6	97.2	99.4	100.0
11 years	6.9	33.0	57.3	74.7	81.1	83.9	87.6	89.5	92.8	94.7	98.3	100.0
Girls												
All ages, 6-11 years	1.6	18.8	44.8	72.4	83.9	88.1	92.1	93.5	96.0	97.3	99.1	100.0
6 years	3.5	18.9	39.1	66.9	86.1	91.7	97.6	99.0	99.7	99.7	100.0	100.0
7 years	0.9	12.1	33.9	71.6	86.7	90.5	95.3	96.6	98.8	99.0	99.7	100.0
8 years	0.7	12.9	41.0	75.2	86.1	91.0	93.4	94.5	96.5	98.0	98.7	100.0
9 years	1.3	19.9	52.0	74.4	84.4	88.5	92.5	93.6	95.6	96.8	99.2	100.0
10 years	1.3	22.8	51.6	75.4	82.0	84.7	87.6	88.9	93.2	95.5	98.9	100.0
11 years	2.2	27.0	52.3	71.4	77.9	81.7	85.4	87.6	91.8	94.3	97.8	100.0

Table 2. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular distance acuity in the better eye, by sex and age: United States, 1963-65

Sex and age	Acuity level											
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	Less than 20/200
	Percentage											
Both sexes												
All ages, 6-11 years	0.5	10.3	18.9	32.3	17.9	6.3	4.4	1.8	3.0	1.3	2.3	1.0
6 years	1.0	9.8	17.7	30.3	22.5	8.4	6.4	1.6	1.5	0.5	0.2	0.1
7 years	0.4	5.9	14.1	34.7	24.6	8.0	5.5	1.4	2.8	1.0	1.5	0.1
8 years	0.5	6.6	16.1	36.6	21.0	6.9	3.6	2.3	2.9	1.1	1.6	0.8
9 years	0.2	10.9	20.9	35.8	14.2	5.4	3.6	1.8	2.7	1.1	2.3	1.1
10 years	0.5	14.1	21.1	31.5	13.2	4.1	2.5	1.8	3.9	2.4	3.4	1.5
11 years	0.3	15.1	23.6	25.1	11.1	4.8	4.6	1.7	4.1	2.2	5.0	2.4
Boys												
All ages, 6-11 years	0.7	11.7	20.3	31.8	16.7	6.0	4.0	1.7	2.8	1.3	2.2	0.8
6 years	1.1	11.4	20.3	31.7	19.8	7.5	4.5	1.2	1.5	0.7	-	0.3
7 years	0.5	6.4	15.5	35.5	21.4	7.9	6.3	1.1	1.6	1.6	2.1	0.1
8 years	0.8	7.1	18.4	34.5	19.9	6.9	3.7	2.6	3.1	1.1	1.6	0.3
9 years	0.4	11.9	23.5	33.8	14.1	5.3	2.9	1.5	2.6	0.9	2.5	0.6
10 years	1.1	16.8	22.5	30.3	12.4	3.6	2.2	1.8	4.1	1.6	2.4	1.2
11 years	0.6	17.4	22.2	24.9	11.8	4.5	4.2	1.7	3.8	1.7	4.9	2.3
Girls												
All ages, 6-11 years	0.2	8.9	17.3	32.9	19.2	6.6	4.9	1.9	3.2	1.4	2.3	1.2
6 years	0.9	8.1	15.1	28.9	25.4	9.3	8.4	1.9	1.5	0.2	0.3	-
7 years	0.3	5.5	12.5	34.0	27.8	8.0	4.7	1.8	4.1	0.4	0.8	0.1
8 years	0.2	6.1	13.7	38.6	22.0	6.9	3.6	2.0	2.8	1.2	1.6	1.3
9 years	-	10.0	18.3	37.8	14.2	5.6	4.4	2.0	2.8	1.2	2.1	1.6
10 years	-	11.3	19.7	32.5	14.1	4.5	2.9	1.9	3.8	3.2	4.4	1.7
11 years	-	12.6	25.0	25.2	10.5	5.2	4.9	1.8	4.4	2.7	5.1	2.6
	Cumulative percentage											
Both sexes												
All ages, 6-11 years	0.5	10.8	29.7	62.0	79.9	86.2	90.6	92.4	95.4	96.7	99.0	100.0
6 years	1.0	10.8	28.5	58.8	81.3	89.7	96.1	97.7	99.2	99.7	99.9	100.0
7 years	0.4	6.3	20.4	55.1	79.7	87.7	93.2	94.6	97.4	98.4	99.9	100.0
8 years	0.5	7.1	23.2	59.8	80.8	87.7	91.3	93.6	96.5	97.6	99.2	100.0
9 years	0.2	11.1	32.0	67.8	82.0	87.4	91.0	92.8	95.5	96.6	98.9	100.0
10 years	0.5	14.6	35.7	67.2	80.4	84.5	87.0	88.8	92.7	95.1	98.5	100.0
11 years	0.3	15.4	39.0	64.1	75.2	80.0	84.6	86.3	90.4	92.6	97.6	100.0
Boys												
All ages, 6-11 years	0.7	12.4	32.7	64.5	81.2	87.2	91.2	92.9	95.7	97.0	99.2	100.0
6 years	1.1	12.5	32.8	64.5	84.3	91.8	96.3	97.5	99.0	99.7	99.7	100.0
7 years	0.5	6.9	22.4	57.9	79.3	87.2	93.5	94.6	96.2	97.8	99.9	100.0
8 years	0.8	7.9	26.3	60.8	80.7	87.6	91.3	93.9	97.0	98.1	99.7	100.0
9 years	0.4	12.3	35.8	69.6	83.7	89.0	91.9	93.4	96.0	96.9	99.4	100.0
10 years	1.1	17.9	40.4	70.7	83.1	86.7	88.9	90.7	94.8	96.4	98.8	100.0
11 years	0.6	18.0	40.2	65.1	76.9	81.4	85.6	87.3	91.1	92.8	97.7	100.0
Girls												
All ages, 6-11 years	0.2	9.1	26.4	59.3	78.5	85.1	90.0	91.9	95.1	96.5	98.8	100.0
6 years	0.9	9.0	24.1	53.0	78.4	87.7	96.1	98.0	99.5	99.7	100.0	100.0
7 years	0.3	5.8	18.3	52.3	80.1	88.1	92.8	94.6	98.7	99.1	99.9	100.0
8 years	0.2	6.3	20.0	58.6	80.6	87.5	91.1	93.1	95.9	97.1	98.7	100.0
9 years	-	10.0	28.3	66.1	80.3	85.9	90.3	92.3	95.1	96.3	98.4	100.0
10 years	-	11.3	31.0	63.5	77.6	82.1	85.0	86.9	90.7	93.9	98.3	100.0
11 years	-	12.6	37.6	62.8	73.3	78.5	83.4	85.2	89.6	92.3	97.4	100.0

Table 3. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular distance acuity in the right eye, by sex and age: United States, 1963-65

Sex and age	Acuity level											
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	Less than 20/200
Both sexes	Percentage											
All ages, 6-11 years-	0.3	5.6	14.9	32.1	20.8	7.8	5.9	3.1	3.4	1.8	2.7	1.6
6 years	0.7	6.9	15.9	27.4	24.9	9.4	8.1	3.1	1.9	0.6	0.4	0.7
7 years	0.2	3.4	10.4	31.8	25.8	11.2	6.9	3.1	3.7	1.1	2.3	0.1
8 years	0.4	3.4	11.0	35.3	24.9	7.5	6.1	3.3	3.5	1.2	2.2	1.2
9 years	0.2	4.9	15.0	37.6	18.8	6.9	4.2	3.1	3.2	1.9	2.5	1.7
10 years	0.3	7.6	17.3	31.5	17.3	5.6	3.9	3.0	4.1	3.2	4.1	2.1
11 years	0.1	7.8	19.8	28.9	12.4	6.1	5.6	3.0	4.2	3.1	5.0	4.0
Boys												
All ages, 6-11 years-	0.5	7.0	16.0	32.2	20.2	7.3	5.3	2.9	2.9	1.6	2.8	1.3
6 years	0.8	8.2	17.5	28.2	24.4	9.0	6.6	1.8	1.5	0.8	0.3	0.9
7 years	0.2	4.4	11.5	33.6	23.6	9.5	6.1	3.3	2.6	1.7	3.4	0.1
8 years	0.8	4.0	13.5	34.3	23.3	7.2	5.8	3.4	3.4	1.5	2.0	0.8
9 years	0.5	6.0	16.2	38.9	18.1	6.8	3.5	2.2	2.6	1.4	2.7	1.1
10 years	0.7	9.5	18.0	31.8	17.3	4.8	3.6	3.7	3.6	1.9	3.4	1.7
11 years	0.2	9.9	19.7	26.4	13.4	6.3	6.4	3.1	3.9	2.4	4.9	3.4
Girls												
All ages, 6-11 years-	0.1	4.2	13.7	32.0	21.5	8.3	6.4	3.3	4.0	2.0	2.6	1.9
6 years	0.7	5.5	14.4	26.7	25.3	9.8	9.6	4.4	2.4	0.3	0.5	0.4
7 years	0.1	2.2	9.3	30.0	28.0	12.8	7.8	3.0	4.9	0.6	1.1	0.2
8 years	-	2.8	8.4	36.5	26.5	7.7	6.5	3.1	3.6	1.0	2.3	1.6
9 years	-	3.8	13.9	36.2	19.7	7.0	4.9	3.9	3.8	2.3	2.2	2.3
10 years	-	5.6	16.7	31.2	17.2	6.4	4.2	2.2	4.7	4.6	4.8	2.4
11 years	-	5.6	19.9	31.4	11.3	5.9	4.9	3.0	4.6	3.7	5.2	4.5
Both sexes	Cumulative percentage											
All ages, 6-11 years-	0.3	5.9	20.8	52.9	73.7	81.5	87.4	90.5	93.9	95.7	98.4	100.0
6 years	0.7	7.6	23.5	50.9	75.8	85.2	93.3	96.4	98.3	98.9	99.3	100.0
7 years	0.2	3.6	14.0	45.8	71.6	82.8	89.7	92.8	96.5	97.6	99.9	100.0
8 years	0.4	3.8	14.8	50.1	75.0	82.5	88.6	91.9	95.4	96.6	98.8	100.0
9 years	0.2	5.1	20.1	57.7	76.5	83.4	87.6	90.7	93.9	95.8	98.3	100.0
10 years	0.3	7.9	25.2	56.7	74.0	79.6	83.5	86.5	90.6	93.8	97.9	100.0
11 years	0.1	7.9	27.7	56.6	69.0	75.1	80.7	83.7	87.9	91.0	96.0	100.0
Boys												
All ages, 6-11 years-	0.5	7.5	23.5	55.7	75.9	83.2	88.5	91.4	94.3	95.9	98.7	100.0
6 years	0.8	9.0	26.5	54.7	79.1	88.1	94.7	96.5	98.0	98.8	99.1	100.0
7 years	0.2	4.6	16.1	49.7	73.3	82.8	88.9	92.2	94.8	96.5	99.9	100.0
8 years	0.8	4.8	18.3	52.6	75.9	83.1	88.9	92.3	95.7	97.2	99.2	100.0
9 years	0.5	6.5	22.7	61.6	79.7	86.5	90.0	92.2	94.8	96.2	98.9	100.0
10 years	0.7	10.2	28.2	60.0	77.3	82.1	85.7	89.4	93.0	94.9	98.3	100.0
11 years	0.2	10.1	29.8	56.2	69.6	75.9	82.3	85.4	89.3	91.7	96.6	100.0
Girls												
All ages, 6-11 years-	0.1	4.3	18.0	50.0	71.5	79.8	86.2	89.5	93.5	95.5	98.1	100.0
6 years	0.7	6.2	20.6	47.3	72.6	82.4	92.0	96.4	98.8	99.1	99.6	100.0
7 years	0.1	2.3	11.6	41.6	69.6	82.4	90.2	93.2	98.1	98.7	99.8	100.0
8 years	-	2.8	11.2	47.7	74.2	81.9	88.4	91.5	95.1	96.1	98.4	100.0
9 years	-	3.8	17.7	53.9	73.6	80.6	85.5	89.4	93.2	95.5	97.7	100.0
10 years	-	5.6	22.3	53.5	70.7	77.1	81.3	83.5	88.2	92.8	97.6	100.0
11 years	-	5.6	25.5	56.9	68.2	74.1	79.0	82.0	86.6	90.3	95.5	100.0

Table 4. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular distance acuity in the left eye, by sex and age: United States, 1963-65

Sex and age	Acuity level											
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	Less than 20/200
	Percentage											
Both sexes												
All ages, 6-11 years	0.3	8.2	16.3	28.9	20.3	8.6	5.3	2.2	3.5	1.8	2.9	1.7
6 years	0.7	7.1	15.9	27.3	25.4	9.7	8.3	2.3	1.6	0.7	0.7	0.3
7 years	0.3	4.4	12.1	30.4	25.6	12.0	7.0	1.6	3.1	1.3	1.8	0.4
8 years	0.3	5.5	13.7	32.3	22.3	10.0	4.7	2.7	3.2	1.6	2.3	1.4
9 years	-	9.3	18.2	31.1	17.9	7.6	4.1	2.4	3.6	1.4	2.9	1.5
10 years	0.5	11.4	18.5	28.8	15.7	5.5	3.6	1.5	4.9	2.9	4.2	2.5
11 years	0.2	12.1	19.6	23.6	14.1	6.6	4.1	2.9	4.8	2.8	5.5	3.7
Boys												
All ages, 6-11 years	0.5	9.2	17.9	29.0	19.0	8.6	4.6	2.2	3.3	1.5	2.9	1.3
6 years	0.7	7.7	18.5	30.9	22.7	8.7	6.1	1.5	1.5	1.1	0.3	0.3
7 years	0.5	4.7	13.7	31.7	21.1	12.7	8.1	1.5	1.6	1.4	2.8	0.2
8 years	0.3	6.0	15.1	30.6	21.6	10.7	4.1	2.9	3.1	1.3	2.9	1.4
9 years	-	9.7	20.7	29.5	18.5	7.4	3.0	2.2	3.9	1.1	3.0	1.0
10 years	0.9	13.7	20.2	28.8	14.0	5.3	3.0	1.4	5.7	1.9	3.3	1.8
11 years	0.5	13.8	19.5	22.2	15.6	6.3	3.1	3.6	4.2	2.1	5.6	3.5
Girls												
All ages, 6-11 years	0.2	7.2	14.6	28.8	21.6	8.7	6.1	2.3	3.7	2.1	2.8	1.9
6 years	0.6	6.5	13.1	23.7	28.1	10.8	10.6	3.2	1.7	0.4	1.1	0.2
7 years	0.1	4.1	10.5	28.9	30.4	11.3	5.8	1.7	4.6	1.3	0.7	0.6
8 years	0.2	4.9	12.2	33.9	23.0	9.4	5.4	2.4	3.3	2.0	1.8	1.5
9 years	-	8.8	15.7	32.8	17.3	7.7	5.2	2.6	3.3	1.7	2.9	2.0
10 years	-	9.0	16.8	28.8	17.5	5.7	4.1	1.7	4.1	3.9	5.3	3.1
11 years	-	10.2	19.7	24.9	12.6	6.9	5.2	2.3	5.4	3.5	5.4	3.9
	Cumulative percentage											
Both sexes												
All ages, 6-11 years	0.3	8.5	24.8	53.7	74.0	82.6	87.9	90.1	93.6	95.4	98.3	100.0
6 years	0.7	7.8	23.7	51.0	76.4	86.1	94.4	96.7	98.3	99.0	99.7	100.0
7 years	0.3	4.7	16.8	47.2	72.8	84.8	91.8	93.4	96.5	97.8	99.6	100.0
8 years	0.3	5.8	19.5	51.8	74.1	84.1	88.8	91.5	94.7	96.3	98.6	100.0
9 years	-	9.3	27.5	58.6	76.5	84.1	88.2	90.6	94.2	95.6	98.5	100.0
10 years	0.5	11.9	30.4	59.2	74.9	80.4	84.0	85.5	90.4	93.3	97.5	100.0
11 years	0.2	12.3	31.9	55.5	69.6	76.2	80.3	83.2	88.0	90.8	96.3	100.0
Boys												
All ages, 6-11 years	0.5	9.7	27.6	56.6	75.6	84.2	88.8	91.0	94.3	95.8	98.7	100.0
6 years	0.7	8.4	26.9	57.8	80.5	89.2	95.3	96.8	98.3	99.4	99.7	100.0
7 years	0.5	5.2	18.9	50.6	71.7	84.4	92.5	94.0	95.6	97.0	99.8	100.0
8 years	0.3	6.3	21.4	52.0	73.6	84.3	88.4	91.3	94.4	95.7	98.6	100.0
9 years	-	9.7	30.4	59.9	78.4	85.8	88.8	91.0	94.9	96.0	99.0	100.0
10 years	0.9	14.6	34.8	63.6	77.6	82.9	85.9	87.3	93.0	94.9	98.2	100.0
11 years	0.5	14.3	33.8	56.0	71.6	77.9	81.0	84.6	88.8	90.9	96.5	100.0
Girls												
All ages, 6-11 years	0.2	7.4	22.0	50.8	72.4	81.1	87.2	89.5	93.2	95.3	98.1	100.0
6 years	0.6	7.1	20.2	43.9	72.0	82.8	93.4	96.6	98.3	98.7	99.8	100.0
7 years	0.1	4.2	14.7	43.6	74.0	85.3	91.1	92.8	97.4	98.7	99.4	100.0
8 years	0.2	5.1	17.3	51.2	74.2	83.6	89.0	91.4	94.7	96.7	98.5	100.0
9 years	-	8.8	24.5	57.3	74.6	82.3	87.5	90.1	93.4	95.1	98.0	100.0
10 years	-	9.0	25.8	54.6	72.1	77.8	81.9	83.6	87.7	91.6	96.9	100.0
11 years	-	10.2	29.9	54.8	67.4	74.3	79.5	81.8	87.2	90.7	96.1	100.0

Table 5. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected binocular near acuity, by sex and age: United States, 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/28	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	72.6	16.6	4.9	2.8	0.8	1.6	0.5	0.2
6 years	75.9	14.2	4.2	3.4	0.8	1.2	0.2	0.1
7 years	60.8	25.3	7.2	3.2	1.0	1.7	0.6	0.2
8 years	68.1	20.5	5.9	2.0	0.8	1.2	0.8	0.7
9 years	74.4	16.0	4.0	2.9	0.8	1.1	0.7	0.1
10 years	78.3	12.0	4.3	2.8	0.5	1.5	0.5	0.1
11 years	78.9	10.9	3.5	2.5	0.7	2.9	0.4	0.2
Boys								
All ages, 6-11 years	75.3	14.5	5.1	2.1	0.7	1.6	0.5	0.2
6 years	79.9	11.3	3.4	3.3	0.7	0.9	0.4	0.1
7 years	63.6	22.8	8.5	2.2	0.6	1.7	0.3	0.3
8 years	69.3	19.0	6.6	1.6	0.9	1.5	0.9	0.2
9 years	77.8	13.8	4.7	1.8	0.5	0.6	0.7	0.1
10 years	81.3	10.9	3.5	1.9	0.5	1.6	0.3	-
11 years	80.7	8.9	3.5	1.9	0.9	3.4	0.4	0.3
Girls								
All ages, 6-11 years	69.8	18.7	4.7	3.5	0.9	1.6	0.6	0.2
6 years	71.9	17.1	5.0	3.6	0.9	1.5	-	-
7 years	57.9	27.8	5.9	4.3	1.5	1.6	0.8	0.2
8 years	66.9	22.1	5.1	2.3	0.7	0.9	0.7	1.3
9 years	71.0	18.3	3.3	4.1	1.1	1.6	0.6	-
10 years	75.2	13.1	5.1	3.7	0.5	1.3	0.9	0.2
11 years	76.9	13.0	3.6	3.2	0.4	2.5	0.3	0.1
	Cumulative percentage							
Both sexes								
All ages, 6-11 years	72.6	89.2	94.1	96.9	97.7	99.3	99.8	100.0
6 years	75.9	90.1	94.3	97.7	98.5	99.7	99.9	100.0
7 years	60.8	86.1	93.3	96.5	97.5	99.2	99.8	100.0
8 years	68.1	88.6	94.5	96.5	97.3	98.5	99.3	100.0
9 years	74.4	90.4	94.4	97.3	98.1	99.2	99.9	100.0
10 years	78.3	90.3	94.6	97.4	97.9	99.4	99.9	100.0
11 years	78.9	89.8	93.3	95.8	96.5	99.4	99.8	100.0
Boys								
All ages, 6-11 years	75.3	89.8	94.9	97.0	97.7	99.3	99.8	100.0
6 years	79.9	91.2	94.6	97.9	98.6	99.5	99.9	100.0
7 years	63.6	86.4	94.9	97.1	97.7	99.4	99.7	100.0
8 years	69.3	88.3	94.9	96.5	97.4	98.9	99.8	100.0
9 years	77.8	91.6	96.3	98.1	98.6	99.2	99.9	100.0
10 years	81.3	92.2	95.7	97.6	98.1	99.7	100.0	100.0
11 years	80.7	89.6	93.1	95.0	95.9	99.3	99.7	100.0
Girls								
All ages, 6-11 years	69.8	88.5	93.2	96.7	97.6	99.2	99.8	100.0
6 years	71.9	89.0	94.0	97.6	98.5	100.0	100.0	100.0
7 years	57.9	85.7	91.6	95.9	97.4	99.0	99.8	100.0
8 years	66.9	89.0	94.1	96.4	97.1	98.0	98.7	100.0
9 years	71.0	89.3	92.6	96.7	97.8	99.4	100.0	100.0
10 years	75.2	88.3	93.4	97.1	97.6	98.9	99.8	100.0
11 years	76.9	89.9	93.5	96.7	97.1	99.6	99.9	100.0

Table 6. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular near acuity in the better eye, by sex and age: United States, 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/28	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	63.0	24.1	5.9	3.3	0.8	2.0	0.7	0.2
6 years	69.0	18.0	6.2	3.9	1.0	1.6	0.2	0.1
7 years	50.1	34.0	7.7	4.2	1.1	2.1	0.6	0.2
8 years	55.1	30.1	7.9	3.2	0.6	1.7	0.8	0.6
9 years	64.3	25.0	4.7	2.7	0.8	1.7	0.7	0.1
10 years	68.7	20.4	4.5	3.3	0.4	1.8	0.9	-
11 years	71.4	16.9	4.2	2.6	0.9	2.9	0.8	0.3
Boys								
All ages, 6-11 years	65.3	22.8	5.6	2.9	0.7	1.8	0.7	0.2
6 years	72.4	15.7	5.5	3.6	0.7	1.6	0.4	0.1
7 years	51.8	32.4	8.1	4.3	0.7	1.9	0.7	0.1
8 years	55.1	31.0	8.0	2.4	0.7	1.7	0.9	0.2
9 years	66.6	24.4	5.0	1.9	0.5	0.6	0.8	0.2
10 years	73.4	18.1	3.2	2.6	0.4	1.8	0.5	-
11 years	73.2	14.8	3.6	2.4	1.1	3.3	1.2	0.4
Girls								
All ages, 6-11 years	60.6	25.5	6.2	3.8	0.9	2.1	0.6	0.3
6 years	65.5	20.5	6.9	4.2	1.3	1.6	-	-
7 years	48.1	35.4	7.4	4.2	1.6	2.4	0.6	0.3
8 years	55.2	29.2	7.9	3.9	0.4	1.6	0.7	1.1
9 years	61.9	25.6	4.4	3.6	1.0	2.8	0.7	-
10 years	63.8	22.8	5.8	4.0	0.5	1.8	1.3	-
11 years	69.7	19.0	4.8	2.7	0.7	2.5	0.5	0.1
	Cumulative percentage							
Both sexes								
All ages, 6-11 years	63.0	87.1	93.0	96.3	97.1	99.1	99.8	100.0
6 years	69.0	87.0	93.2	97.1	98.1	99.7	99.9	100.0
7 years	50.1	84.1	91.8	96.0	97.1	99.2	99.8	100.0
8 years	55.1	85.2	93.1	96.3	96.9	98.6	99.4	100.0
9 years	64.3	89.3	94.0	96.7	97.5	99.2	99.9	100.0
10 years	68.7	89.1	93.6	96.9	97.3	99.1	100.0	100.0
11 years	71.4	88.3	92.5	95.1	96.0	98.9	99.7	100.0
Boys								
All ages, 6-11 years	65.3	88.1	93.7	96.6	97.3	99.1	99.8	100.0
6 years	72.4	88.1	93.6	97.2	97.9	99.5	99.9	100.0
7 years	51.8	84.2	92.3	96.6	97.3	99.2	99.9	100.0
8 years	55.1	86.1	94.1	96.5	97.2	98.9	99.8	100.0
9 years	66.6	91.0	96.0	97.9	98.4	99.0	99.8	100.0
10 years	73.4	91.5	94.7	97.3	97.7	99.5	100.0	100.0
11 years	73.2	88.0	91.6	94.0	95.1	98.4	99.6	100.0
Girls								
All ages, 6-11 years	60.6	86.1	92.3	96.1	97.0	99.1	99.7	100.0
6 years	65.5	86.0	92.9	97.1	98.4	100.0	100.0	100.0
7 years	48.1	83.5	90.9	95.1	96.7	99.1	99.7	100.0
8 years	55.2	84.4	92.3	96.2	96.6	98.2	98.9	100.0
9 years	61.9	87.5	91.9	95.5	96.5	99.3	100.0	100.0
10 years	63.8	86.6	92.4	96.4	96.9	98.7	100.0	100.0
11 years	69.7	88.7	93.5	96.2	96.9	99.4	99.9	100.0

Table 7. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular near acuity in the right eye, by sex and age: United States, 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/28	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	54.4	26.1	8.9	4.8	1.5	2.7	1.0	0.6
6 years	64.3	18.6	7.6	4.9	1.6	1.9	0.4	0.7
7 years	43.1	33.8	11.0	6.1	2.0	2.9	0.7	0.4
8 years	45.7	31.5	12.1	4.6	1.4	2.6	1.0	1.1
9 years	54.7	26.2	9.1	4.3	1.4	2.9	1.1	0.3
10 years	58.6	24.6	6.8	4.8	1.2	2.2	1.6	0.2
11 years	60.4	21.4	6.7	4.2	1.6	3.5	1.2	1.0
Boys								
All ages, 6-11 years	56.3	25.0	8.6	4.4	1.4	2.7	0.9	0.7
6 years	66.5	17.5	7.0	4.3	1.0	2.0	0.7	1.0
7 years	44.5	32.8	10.4	6.5	1.5	3.0	0.7	0.6
8 years	45.6	32.3	12.7	3.4	1.5	2.8	0.9	0.8
9 years	57.5	24.8	9.6	3.7	1.2	2.0	0.8	0.4
10 years	61.9	22.7	5.8	4.4	1.5	2.5	1.2	-
11 years	61.9	19.5	5.9	3.9	2.0	4.1	1.2	1.5
Girls								
All ages, 6-11 years	52.4	27.2	9.3	5.3	1.6	2.6	1.1	0.5
6 years	62.0	19.7	8.2	5.5	2.3	1.7	0.2	0.4
7 years	41.4	34.9	11.7	5.7	2.4	2.8	0.8	0.3
8 years	45.7	30.7	11.5	5.9	1.3	2.1	1.3	1.5
9 years	51.7	27.7	8.7	4.9	1.6	3.8	1.4	0.2
10 years	55.2	26.6	7.9	5.1	0.9	2.0	1.9	0.4
11 years	59.0	23.3	7.5	4.5	1.1	3.0	1.1	0.5
	Cumulative percentage							
Both sexes								
All ages, 6-11 years	54.4	80.5	89.4	94.2	95.7	98.4	99.4	100.0
6 years	64.3	82.9	90.5	95.4	97.0	98.9	99.3	100.0
7 years	43.1	76.9	87.9	94.0	96.0	98.9	99.6	100.0
8 years	45.7	77.2	89.3	93.9	95.3	97.9	98.9	100.0
9 years	54.7	80.9	90.0	94.3	95.7	98.6	99.7	100.0
10 years	58.6	83.2	90.0	94.8	96.0	98.2	99.8	100.0
11 years	60.4	81.8	88.5	92.7	94.3	97.8	99.0	100.0
Boys								
All ages, 6-11 years	56.3	81.3	89.9	94.3	95.7	98.4	99.3	100.0
6 years	66.5	84.0	91.0	95.3	96.3	98.3	99.0	100.0
7 years	44.5	77.3	87.7	94.2	95.7	98.7	99.4	100.0
8 years	45.6	77.9	90.6	94.0	95.5	98.3	99.2	100.0
9 years	57.5	82.3	91.9	95.6	96.8	98.8	99.6	100.0
10 years	61.9	84.6	90.4	94.8	96.3	98.8	100.0	100.0
11 years	61.9	81.4	87.3	91.2	93.2	97.3	98.5	100.0
Girls								
All ages, 6-11 years	52.4	79.6	88.9	94.2	95.8	98.4	99.5	100.0
6 years	62.0	81.7	89.9	95.4	97.7	99.4	99.6	100.0
7 years	41.4	76.3	88.0	93.7	96.1	98.9	99.7	100.0
8 years	45.7	76.4	87.9	93.8	95.1	97.2	98.5	100.0
9 years	51.7	79.4	88.1	93.0	94.6	98.4	99.8	100.0
10 years	55.2	81.8	89.7	94.8	95.7	97.7	99.6	100.0
11 years	59.0	82.3	89.8	94.3	95.4	98.4	99.5	100.0

Table 8. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected monocular near acuity in the left eye, by sex and age: United States, 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/28	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	52.7	29.2	8.2	3.9	1.6	2.8	1.0	0.6
6 years	62.2	20.2	8.7	3.9	1.7	2.8	0.4	0.1
7 years	41.0	37.2	10.7	5.2	1.7	2.9	0.9	0.4
8 years	43.7	36.6	9.5	4.2	1.3	2.6	0.9	1.2
9 years	51.8	31.4	7.6	3.9	1.0	2.9	1.1	0.3
10 years	57.4	26.8	6.0	3.4	1.6	2.7	1.4	0.7
11 years	60.4	21.4	6.7	4.2	1.5	3.5	1.2	1.1
Boys								
All ages, 6-11 years	55.7	27.4	7.7	3.8	1.5	2.3	1.0	0.6
6 years	65.9	18.9	7.3	3.7	1.4	2.1	0.4	0.3
7 years	43.3	35.0	10.2	5.6	2.1	2.6	0.9	0.3
8 years	45.2	35.6	9.3	3.4	1.7	2.8	0.9	1.1
9 years	54.3	29.5	8.7	3.6	1.0	1.7	0.9	0.3
10 years	61.7	26.1	4.5	3.0	1.0	2.1	0.9	0.7
11 years	64.3	18.9	5.9	3.0	2.1	2.6	2.0	1.2
Girls								
All ages, 6-11 years	49.7	31.1	8.6	4.1	1.6	3.3	1.1	0.5
6 years	58.5	21.5	10.1	4.0	2.1	3.5	0.3	-
7 years	38.6	39.4	11.2	4.8	1.4	3.2	0.8	0.6
8 years	42.2	37.5	9.8	5.0	1.0	2.4	0.8	1.3
9 years	49.3	33.3	6.5	4.1	1.1	4.1	1.4	0.2
10 years	53.0	27.4	7.6	3.9	2.1	3.3	1.9	0.8
11 years	56.8	27.2	6.4	2.5	2.2	3.3	1.2	0.4
	Cumulative percentage							
Both sexes								
All ages, 6-11 years	52.7	81.9	90.1	94.0	95.6	98.4	99.4	100.0
6 years	62.2	82.4	91.1	95.0	96.7	99.5	99.9	100.0
7 years	41.0	78.2	88.9	94.1	95.8	98.7	99.6	100.0
8 years	43.7	80.3	89.8	94.0	95.3	97.9	98.8	100.0
9 years	51.8	83.2	90.8	94.7	95.7	98.6	99.7	100.0
10 years	57.4	84.2	90.2	93.6	95.2	97.9	99.3	100.0
11 years	60.4	81.8	88.5	92.7	94.2	97.7	98.9	100.0
Boys								
All ages, 6-11 years	55.7	83.1	90.8	94.6	96.1	98.4	99.4	100.0
6 years	65.9	84.8	92.1	95.8	97.2	99.3	99.7	100.0
7 years	43.3	78.3	88.5	94.1	96.2	98.8	99.7	100.0
8 years	45.2	80.8	90.1	93.5	95.2	98.0	98.9	100.0
9 years	54.3	83.8	92.5	96.1	97.1	98.8	99.7	100.0
10 years	61.7	87.8	92.3	95.3	96.3	98.4	99.3	100.0
11 years	64.3	83.2	89.1	92.1	94.2	96.8	98.8	100.0
Girls								
All ages, 6-11 years	49.7	80.8	89.4	93.5	95.1	98.4	99.5	100.0
6 years	58.5	80.0	90.1	94.1	96.2	99.7	100.0	100.0
7 years	38.6	78.0	89.2	94.0	95.4	98.6	99.4	100.0
8 years	42.2	79.7	89.5	94.5	95.5	97.9	98.7	100.0
9 years	49.3	82.6	89.1	93.2	94.3	98.4	99.8	100.0
10 years	53.0	80.4	88.0	91.9	94.0	97.3	99.2	100.0
11 years	56.8	84.0	90.4	92.9	95.1	98.4	99.6	100.0

Table 9. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected binocular distance acuity on the Master Ortho-rater letter slides, by sex and age: United States, 1963-65

Sex and age	Acuity level											
	20/12 or better	20/15	20/17	20/20	20/25	20/30	20/40	20/50	20/70	20/100	20/200	Less than 20/200
	Percentage											
Both sexes												
All ages, 6-11 years	2.2	18.3	26.7	27.6	9.6	3.5	3.7	1.4	2.7	1.3	2.1	0.9
6 years	-	6.8	18.4	42.5	15.7	6.5	6.5	1.4	1.3	0.3	0.4	0.2
7 years	-	6.9	22.5	41.3	15.6	3.7	4.5	0.9	2.8	0.5	1.0	0.3
8 years	1.3	14.2	27.0	32.9	10.8	4.4	3.1	1.7	1.7	0.9	1.1	0.9
9 years	1.8	21.0	32.2	23.0	8.4	3.3	3.5	1.1	1.9	1.2	1.9	0.7
10 years	3.4	24.3	27.7	22.3	6.6	2.1	2.9	1.5	3.5	2.0	2.9	0.8
11 years	4.7	25.4	25.0	18.2	6.3	3.3	3.7	2.0	3.7	2.1	3.6	2.0
Boys												
All ages, 6-11 years	3.3	20.5	26.7	26.6	8.9	3.0	3.5	1.5	2.3	1.1	2.0	0.6
6 years	-	7.8	21.0	47.1	10.7	6.5	3.7	1.0	0.9	0.6	-	0.7
7 years	-	7.4	24.8	38.7	15.6	3.6	4.0	0.7	2.9	0.7	1.4	0.2
8 years	1.9	17.2	26.3	31.0	10.5	3.7	3.8	2.2	1.2	0.3	1.5	0.4
9 years	2.4	23.3	31.9	24.0	6.8	2.4	3.1	1.0	1.8	1.3	1.4	0.6
10 years	5.4	27.7	26.7	20.2	6.6	1.7	3.0	1.6	2.7	1.6	2.3	0.5
11 years	7.0	26.2	24.4	17.4	6.5	2.7	3.7	1.8	3.2	1.8	3.6	1.7
Girls												
All ages, 6-11 years	1.0	16.1	26.6	28.7	10.3	4.1	3.8	1.4	3.0	1.6	2.2	1.2
6 years	-	6.0	16.3	38.8	19.6	6.5	8.7	1.8	1.7	-	0.6	-
7 years	-	6.4	20.3	43.7	15.7	3.8	4.9	1.1	2.7	0.3	0.7	0.4
8 years	0.6	11.1	27.8	34.6	11.2	5.2	2.4	1.2	2.1	1.6	0.8	1.4
9 years	1.1	18.8	32.4	21.8	10.1	4.3	3.9	1.1	2.0	1.2	2.5	0.8
10 years	1.4	20.5	28.7	24.6	6.6	2.6	2.9	1.3	4.4	2.4	3.5	1.1
11 years	2.3	24.6	25.6	18.9	6.2	3.9	3.7	2.2	4.2	2.5	3.6	2.3
	* Cumulative percentage											
Both sexes												
All ages, 6-11 years	2.2	20.5	47.2	74.8	84.4	87.9	91.6	93.0	95.7	97.0	99.1	100.0
6 years	0.0	6.8	25.2	67.7	83.4	89.9	96.4	97.8	99.1	99.4	99.8	100.0
7 years	0.0	6.9	29.4	70.7	86.3	90.0	94.5	95.4	98.2	98.7	99.7	100.0
8 years	1.3	15.5	42.5	75.4	86.2	90.6	93.7	95.4	97.1	98.0	99.1	100.0
9 years	1.8	22.8	55.0	78.0	86.4	89.7	93.2	94.3	96.2	97.4	99.3	100.0
10 years	3.4	27.7	55.4	77.7	84.3	86.4	89.3	90.8	94.3	96.3	99.2	100.0
11 years	4.7	30.1	55.1	73.3	79.6	82.9	86.6	88.6	92.3	94.4	98.0	100.0
Boys												
All ages, 6-11 years	3.3	23.8	50.5	77.1	86.0	89.0	92.5	94.0	96.3	97.4	99.4	100.0
6 years	0.0	7.8	28.8	75.9	86.6	93.1	96.8	97.8	98.7	99.3	99.3	100.0
7 years	0.0	7.4	32.2	70.9	86.5	90.1	94.1	94.8	97.7	98.4	99.8	100.0
8 years	1.9	19.1	45.4	76.4	86.9	90.6	94.4	96.6	97.8	98.1	99.6	100.0
9 years	2.4	25.7	57.6	81.6	88.4	90.8	93.9	94.9	96.7	98.0	99.4	100.0
10 years	5.4	33.1	59.8	80.0	86.6	88.3	91.3	92.9	95.6	97.2	99.5	100.0
11 years	7.0	33.2	57.6	75.0	81.5	84.2	87.9	89.7	92.9	94.7	98.3	100.0
Girls												
All ages, 6-11 years	1.0	17.1	43.7	72.4	82.7	86.8	90.6	92.0	95.0	96.6	98.8	100.0
6 years	0.0	6.0	22.3	61.1	80.7	87.2	95.9	97.7	99.4	99.4	100.0	100.0
7 years	0.0	6.4	26.7	70.4	86.1	89.9	94.8	95.9	98.6	98.9	99.6	100.0
8 years	0.6	11.7	39.5	74.1	85.3	90.5	92.9	94.1	96.2	97.8	98.6	100.0
9 years	1.1	19.9	52.3	74.1	84.2	88.5	92.4	93.5	95.5	96.7	99.2	100.0
10 years	1.4	21.9	50.6	75.2	81.8	84.4	87.3	88.6	93.0	95.4	98.9	100.0
11 years	2.3	26.9	52.5	71.4	77.6	81.5	85.2	87.4	91.6	94.1	97.7	100.0

Table 10. Percentage of children, 6-11 years, reaching or reaching and exceeding specified acuity levels for uncorrected binocular distance acuity on the Landolt rings chart, by sex and age: United States, 1963-65

Sex and age	Acuity level											
	20/10.7 or better	20/14.3	20/17.9	20/21.4	20/25	20/28.6	20/39.3	20/50	20/71.4	20/100	20/200	Less than 20/200
Both sexes	Percentage											
All ages, 6-11 years-	4.5	24.5	23.3	22.5	13.9	4.3	4.4	1.1	0.8	0.3	0.3	0.1
6 years	4.0	23.5	22.9	23.7	15.1	4.2	4.6	0.8	0.8	0.2	0.1	0.1
7 years	6.1	24.7	24.9	18.4	13.3	5.1	3.5	2.2	1.0	0.2	0.6	-
8 years	4.7	29.1	22.2	26.7	7.7	3.4	6.2	-	-	-	-	-
9 years	6.7	21.6	21.5	30.1	9.6	1.6	6.7	-	-	-	2.2	-
10 years	-	45.4	34.0	4.2	8.0	5.4	3.0	-	-	-	-	-
11 years	-	28.3	8.2	24.0	14.4	5.4	-	7.7	5.3	6.7	-	-
Boys												
All ages, 6-11 years-	4.7	27.2	23.4	21.7	11.8	4.1	4.2	1.0	1.1	0.5	0.2	0.1
6 years	3.3	27.8	24.0	23.7	11.5	3.1	4.4	0.4	1.2	0.4	-	0.2
7 years	8.2	24.5	24.0	16.3	13.4	6.4	2.7	2.6	1.1	0.4	0.4	-
8 years	6.8	32.2	13.7	24.7	8.5	4.8	9.3	-	-	-	-	-
9 years	6.5	29.3	17.7	19.9	12.3	3.3	6.5	-	-	-	4.5	-
10 years	-	28.4	42.2	13.7	15.7	-	-	-	-	-	-	-
11 years	-	17.2	17.2	13.8	-	11.2	-	16.1	11.0	13.5	-	-
Girls												
All ages, 6-11 years-	4.3	21.6	23.3	23.4	16.3	4.6	4.6	1.2	0.4	-	0.3	-
6 years	4.8	18.8	21.6	23.7	19.0	5.3	4.9	1.3	0.4	-	0.2	-
7 years	3.6	24.8	25.8	21.0	13.3	3.7	4.5	1.8	0.8	-	0.7	-
8 years	2.5	25.8	31.1	28.9	6.8	1.9	3.0	-	-	-	-	-
9 years	7.0	13.9	25.0	40.1	7.0	-	7.0	-	-	-	-	-
10 years	-	52.9	30.4	-	4.6	7.8	4.3	-	-	-	-	-
11 years	-	38.7	-	33.5	27.8	-	-	-	-	-	-	-
Both sexes	Cumulative percentage											
All ages, 6-11 years-	4.5	29.0	52.3	74.8	88.7	93.0	97.4	98.5	99.3	99.6	99.9	100.0
6 years	4.0	27.5	50.4	74.1	89.2	93.4	98.0	98.8	99.6	99.8	99.9	100.0
7 years	6.1	30.8	55.7	74.1	87.4	92.5	96.0	98.2	99.2	99.4	100.0	100.0
8 years	4.7	33.8	56.0	82.7	90.4	93.8	100.0	100.0	100.0	100.0	100.0	100.0
9 years	6.7	28.3	49.8	79.9	89.5	91.1	97.8	97.8	97.8	97.8	100.0	100.0
10 years	0.0	45.4	79.4	83.6	91.6	97.0	100.0	100.0	100.0	100.0	100.0	100.0
11 years	0.0	28.3	36.5	60.5	74.9	80.3	80.3	88.0	93.3	100.0	100.0	100.0
Boys												
All ages, 6-11 years-	4.7	31.9	55.3	77.0	88.8	92.9	97.1	98.1	99.2	99.7	99.9	100.0
6 years	3.3	31.1	55.1	78.8	90.3	93.4	97.8	98.2	99.4	99.8	99.8	100.0
7 years	8.2	32.7	56.7	73.0	86.4	92.8	95.5	98.1	99.2	99.6	100.0	100.0
8 years	6.8	39.0	52.7	77.4	85.9	90.7	100.0	100.0	100.0	100.0	100.0	100.0
9 years	6.5	35.8	53.5	73.4	85.7	89.0	95.5	95.5	95.5	95.5	100.0	100.0
10 years	0.0	28.4	70.6	84.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
11 years	0.0	17.2	34.4	48.2	48.2	59.4	59.4	75.5	86.5	100.0	100.0	100.0
Girls												
All ages, 6-11 years-	4.3	25.9	49.2	72.6	88.9	93.5	98.1	99.3	99.7	99.7	100.0	100.0
6 years	4.8	23.6	45.2	68.9	87.9	93.2	98.1	99.4	99.8	99.8	100.0	100.0
7 years	3.6	28.4	54.2	75.2	88.5	92.2	96.7	98.5	99.3	99.3	100.0	100.0
8 years	2.5	28.3	59.4	88.3	95.1	97.0	100.0	100.0	100.0	100.0	100.0	100.0
9 years	7.0	20.9	45.9	86.0	93.0	93.0	100.0	100.0	100.0	100.0	100.0	100.0
10 years	0.0	52.9	83.3	83.3	87.9	95.7	100.0	100.0	100.0	100.0	100.0	100.0
11 years	-	38.7	38.7	72.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 11. Percentage of children, 6-11 years, reaching specified acuity levels for uncorrected binocular near acuity on the Master Ortho-rater letter slides, by sex and age: United States, 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/28	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	69.1	19.4	5.3	2.9	0.7	1.7	0.6	0.3
6 years	42.5	40.1	8.7	4.9	0.8	2.4	0.6	-
7 years	51.1	33.3	8.0	4.0	0.9	1.7	0.7	0.3
8 years	66.6	21.9	6.1	1.9	0.8	1.3	0.7	0.7
9 years	73.9	16.5	4.1	2.9	0.7	1.1	0.7	0.1
10 years	77.9	12.2	4.4	2.8	0.5	1.5	0.6	0.1
11 years	78.8	10.9	3.5	2.6	0.7	2.9	0.4	0.2
Boys								
All ages, 6-11 years	72.2	16.9	5.8	1.9	0.6	1.8	0.6	0.2
6 years	52.7	33.6	8.9	1.4	-	2.1	1.3	-
7 years	53.1	30.5	10.7	2.6	0.3	1.9	0.5	0.4
8 years	67.9	20.0	7.1	1.5	1.0	1.6	0.7	0.2
9 years	77.4	14.2	4.9	1.9	0.3	0.5	0.7	0.1
10 years	81.2	11.1	3.5	1.7	0.5	1.7	0.3	-
11 years	80.9	8.8	3.5	1.9	0.9	3.3	0.4	0.3
Girls								
All ages, 6-11 years	65.9	21.8	4.8	4.0	0.9	1.7	0.6	0.3
6 years	34.4	45.2	8.6	7.7	1.5	2.6	-	-
7 years	48.9	36.1	5.4	5.4	1.6	1.5	0.9	0.2
8 years	65.2	23.6	5.2	2.3	0.6	1.0	0.7	1.4
9 years	70.2	18.9	3.4	4.1	1.1	1.7	0.6	-
10 years	74.4	13.4	5.3	3.8	0.6	1.4	0.9	0.2
11 years	76.6	13.1	3.6	3.3	0.4	2.5	0.3	0.2

Table 12. Percentage of children, 6-11 years, reaching specified acuity levels for uncorrected binocular near acuity on the Landolt rings chart, by sex and age: United States 1963-65

Sex and age	Acuity level							
	14/14 or better	14/17.5	14/21	14/26	14/35	14/49 and 14/70	14/140	Less than 14/140
	Percentage							
Both sexes								
All ages, 6-11 years	86.5	5.6	3.2	2.5	0.9	1.0	0.2	0.1
6 years	86.3	6.1	2.8	3.0	0.8	0.8	0.1	0.1
7 years	85.6	4.9	5.1	1.3	1.2	1.6	0.3	-
8 years	87.2	5.5	2.4	2.5	-	0.9	1.5	-
9 years	92.7	-	2.6	2.5	2.2	-	-	-
10 years	93.3	2.7	-	4.0	-	-	-	-
11 years	85.8	7.7	-	-	-	6.5	-	-
Boys								
All ages, 6-11 years	86.9	5.5	2.2	3.1	1.0	0.9	0.3	0.1
6 years	86.9	5.5	2.0	3.8	0.8	0.6	0.2	0.2
7 years	87.5	5.2	3.3	1.4	1.3	1.3	-	-
8 years	85.6	7.2	1.4	2.9	-	-	2.9	-
9 years	90.4	-	-	-	5.1	4.5	-	-
10 years	87.1	-	-	12.9	-	-	-	-
11 years	70.5	16.0	-	-	-	13.5	-	-
Girls								
All ages, 6-11 years	85.9	5.8	4.3	1.8	0.8	1.2	0.2	-
6 years	85.7	6.8	3.7	2.0	0.7	1.1	-	-
7 years	83.3	4.6	7.1	1.0	1.3	1.9	0.8	-
8 years	88.8	3.7	3.5	2.1	1.9	-	-	-
9 years	94.9	-	-	5.1	-	-	-	-
10 years	96.0	4.0	-	-	-	-	-	-
11 years	100.0	-	-	-	-	-	-	-

APPENDIX I

STATISTICAL NOTES

The Survey Design

The sample design for the second cycle of the Health Examination Survey, similar to the one used for the first cycle, was that of a multistage, stratified probability sample of loose clusters of persons in land-based segments. Successive elements dealt with in the process of sampling are primary sampling unit (PSU), census enumeration district (ED), segment, household, eligible child (EC), and finally, the sample child (SC).

At the first stage, the nearly 2,000 PSU's into which the United States (including Hawaii and Alaska) has been divided and then grouped into 357 strata for use in the Current Population Survey and the Health Interview Survey were further grouped into 40 superstrata for use in Cycle II of the Health Examination Survey. The average size of each Cycle II stratum was 4.5 million persons, and all fell between the limits of 3.5 and 5.5 million. Grouping into 40 strata was done in a way that maximized homogeneity of the PSU's included in each stratum, particularly with regard to degree of urbanization, geographic proximity, and degree of industrialization. The 40 strata were classified into four broad geographic regions (each with 10 strata) of approximately equal population and cross-classified into four broad population density groups (each having 10 strata). Each of the 16 cells contained either two or three strata. A single stratum might include only one PSU (or only part of a PSU as for example New York City which represented two strata) or several score PSU's.

To take account of the possible effect that the rate of population change between the 1950 census and 1960 census might have had on health, the 10 strata within each region were further classified into four classes ranging from those with no increase to those with the greatest relative increase. Each such class contained either two or three strata.

One PSU was then selected from each of the 40 strata. A controlled selection technique was used in which the probability of selection of a particular PSU was proportional to its 1960 population. In the controlled selection an attempt was also made to maximize the spread of the PSU's among the States. While not every one of the 64 cells in the 4 x 4 x 4 grid contributes a PSU to the sample of 40 PSU's, the controlled selection technique ensured the sample's matching the marginal distributions in all three dimensions and being closely representative of all cross-classifications.

Generally, within a particular PSU, 20 ED's were selected with the probability of selection of a particular ED proportional to its population in the age group 5-9 years in the 1960 census, which by 1963 roughly approximated the population in the target age group for Cycle II. A similar method was used for selecting one segment (cluster of households) in each ED. Each of the resultant 20 segments was either a bounded area or a cluster of households (or addresses). All of the children in the age range properly resident at the address visited were EC. Operational considerations made it necessary to reduce the number of prospective examinees at any one location to a maximum of 200. The EC to be excluded for this reason from the SC group was determined by systematic subsampling.

The total sample included 7,417 children in the 6-11-year-age group with approximately 1,000 in each of the single years of age and from 25 different States.

Reliability

Measurement processes employed in the survey were highly standarized and closely controlled. Of course this does not mean that the correspondence between the real world and the survey results is exact. Data from the survey are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

The first report on Cycle II[4] describes in detail the faithfulness with which the sampling design was carried out. It notes that out of the 7,417 sample children, the 7,119 who were examined—a response rate of 96 percent—gave evidence that they were a highly representative sample of children of this age in the noninstitutional population of the United States. The response levels for the various demographic subgroups, including those for age, sex, race, region, population density, parent's educational level, and family in-

come, show no marked differentials. Hence, it appears unlikely that nonresponse could bias the findings much in these respects.

Measures used to control the quality of data from this survey in general have been cited previously;[4] those relating specifically to the vision tests are outlined in an earlier section of this report.

Data recorded for each sample child are inflated in the estimation process to characterize the larger universe of which the sample child is representative. The weights used in this inflation process are a product of the reciprocal of the probability of selecting the child, an adjustment for nonresponse cases, and a post-stratified ratio adjustment which increases precision by bringing survey results into closer alignment with known U.S. population figures by color and sex for single years of age, 6-11.

In the second cycle of the Health Examination Survey the sample was the result of three stages of selection—the single PSU from each stratum, the 20 segments from each sample PSU, and the sample children from the eligible children. The probability of selecting an individual child is the product of the probability of selection at each stage.

Since the strata are roughly equal in population size and a nearly equal number of sample children were examined in each of the sample PSU's, the sample design is essentially self-weighting with respect to the target population, that is, each child 6-11 years of age had about the same probability of being drawn into the sample.

The adjustment upward for nonresponse is intended to minimize the impact of nonresponse on final estimates by imputing to nonrespondents the characteristics of "similar" respondents. Here "similar" respondents were judged to be examined children in a sample PSU having the same age (in years) and sex as children not examined in that sample PSU.

The post-stratified ratio adjustment used in the second cycle achieved most of the gains in precision which would have been attained if the sample had been drawn from a population stratified by age, color, and sex, and makes the final sample estimates of population agree exactly with independent controls prepared by the Bureau of the Census for the U.S. noninstitutional population as of August 1, 1964 (approximate midsurvey point) by color and sex for each single year of age 6-11. The weights of every responding sample child in each of the 24 age, color, and sex classes is adjusted upwards or downwards so that the weighted total within the class equals the independent population control.

In addition to children not examined at all, there were some whose examination was incomplete in one procedure or another. The extent of missing data for the visual acuity test is shown in table I.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques.

The probability design of the survey makes possible the calculation of sampling errors. The sampling error is used here to determine how imprecise the survey test results may be because they come from a sample rather than from the measurements of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure are complex and accordingly require computationally involved techniques for the calculation of variances, and (3) from

Table I. Number of examinees and extent of missing visual acuity tests, by age: Health Examination Survey, 1963-65

Item missing	Total	6 years	7 years	8 years	9 years	10 years	11 years
	Number of examinees						
All examinees	7,119	1,111	1,241	1,231	1,184	1,160	1,192
Not given vision battery	36	12	10	4	4	5	1
Parts only missing:							
Distance							
Right eye	87	43	20	10	5	6	3
Left eye	89	46	18	9	5	7	4
Binocular	69	32	16	7	4	6	4
Near							
Right eye	70	32	18	9	4	5	2
Left eye	72	35	18	7	3	6	3
Binocular	60	27	15	7	3	5	3

the survey are coming thousands of statistics, many for subclasses of the population for which there are a small number of cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error when the number of cases in a cell is small or even occasionally when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are presented in table II. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of the measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic, with 68-percent confidence; or the range within two standard errors of the tabulated statistic, with 95-percent confidence. The latter is used as the level of significance in this report.

An overestimate of the standard error of a difference $d = \underline{x} - \underline{y}$ of two statistics $\underline{x}$ and $\underline{y}$ is given by the formula $S_d = (S_x^2 + S_y^2)^{1/2}$ where S_x and S_y are the sampling errors, respectively of x and y, shown in table II.

Small Categories

In some tables magnitudes are shown for cells for which the sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously, in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included in the belief that they may help to convey an impression of the overall story of the table.

Table II. Standard error expressed in percentage for percent of persons with a specified acuity level: United States, 1963-65

Test and age	Prevalence in percentage				
	1 or 99	5 or 95	10 or 90	25 or 75	50
Both tests	Standard error in percentage points				
All ages, 6-11 years---	0.3	0.5	0.8	1.0	1.5
6 years----------	0.5	0.8	1.2	1.6	2.2
7 years----------	0.5	0.8	1.2	1.6	2.2
8 years----------	0.5	0.8	1.2	1.6	2.2
9 years----------	0.5	0.8	1.2	1.6	2.2
10 years----------	0.5	0.8	1.2	1.6	2.2
11 years----------	0.5	0.8	1.2	1.6	2.2
Letter test					
All ages, 6-11 years---	0.3	0.5	0.8	1.0	1.5
6 years----------	0.9	2.0	3.0	4.0	5.0
7 years----------	0.8	1.0	1.5	2.5	3.0
8 years----------	0.6	0.8	1.2	1.6	2.2
9 years----------	0.5	0.8	1.2	1.6	2.2
10 years----------	0.5	0.8	1.2	1.6	2.2
11 years----------	0.5	0.8	1.2	1.6	2.2
Landolt ring					
All ages, 6-11 years---	0.4	0.9	1.6	2.1	2.8
6 years----------	0.6	1.2	1.9	2.5	3.0
7 years----------	0.9	1.7	3.5	4.5	6.0
8 years----------	*	*	*	*	*
9 years----------	*	*	*	*	*
10 years----------	*	*	*	*	*
11 years----------	*	*	*	*	*

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APPENDIX II

TARGET SPECIFICATIONS FOR VISION TESTING

Scoring Sheets Used for Master Ortho-Rater Test

HEALTH EXAMINATION SURVEY—II

VISION—DISTANCE

VISION TESTS (without glasses)

Check tests given first. ☐ Far ☐ Near (Odd numbers far first; even numbers near first)

DIAL

2. MONOCULAR DISTANCE—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	VHDNS OZKRC	 50	CDZNO KSRVH	 50
6	DVZNC SRHKO	 40	CNRKH ZVSDO	 40
7	KNZCO SRDHV	 30	DVHCK OZNSR	 30
8	KNDRS ZVCOH	 25	CDKRO SZVNH	 25
9	VZCHD KNRSO	 20	CVHSZ ORKDN	 20
10	KZSVN HCRDO	 17	DNVHS OKRCZ	 17
11	RCSNV KDHOZ	 15	ZHODC SVNKR	 15
12	ROKHZ NSCVD	 12	KHOZD CSNVR	 12

3. MONOCULAR DISTANCE—LARGE*
(Omit if score on Dial 2)

Line	Right eye	Score	Left eye	Score
1	SDK	 400	VNC	 400
2	RCSZO / KNHDV	 200	OZNKS / DRHCV	 200
3	HNZOS KRCVD	 100	RZOHC KSNDV	 100
4	ZHODC SVNKR	 70	RKNCZ HSDVO	 70

CODE ..... CODE .....

3A. BINOCULAR DISTANCE—SMALL*

Line	Score
5	OSDNH VKZCR 50
6	RHZCD OSVKN 40
7	SVNHO KCRDZ 30
8	RHSCK OZDVN 25
9	OZRVN HSCKD 20
10	DRHVN ZSKCO 17
11	OSKCV RZHDN 15
12	SKHDN OCVRZ 12

4A. BINOCULAR DISTANCE—LARGE*
(Omit if score on Dial 3A)

Line	Score
1	KDS 400
2 / 2	ZSKCO / VRHDN 200
3	ZNSKH VDRCO 100
4	OZCRH NSKDV 70

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.
**Retest with diopter (3+) lenses *at level reached* only those who score 20, 17, 15, or 12, on regular test. Binocular distance, test without regular glasses only.

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SAMPLE NO.

HEALTH EXAMINATION SURVEY—II

VISION—NEAR

7. MONOCULAR NEAR—SMALL*

Line	Right eye	Score (check)	Left eye	Score
5	CVRZS DKHNO	 50	ZKCRV OHSDN	 50
6	VZKCO HRSDN	 40	SDKVO ZRHNC	 40
7	HSZKN OVCDR	 30	DHZRV SOKNC	 30
8	OVRHS CNDZK	 25	DKOSN RVZCH	 25
9	ZHCOR VDNSK	 20	RKZVD OSNCH	 20
10	RHCVN SDKZO	 17	OKSRN DHVCZ	 17
11	CNZSR OHKDV	 15	VRCHN OZKSD	 15
12	ODCNH VRSKZ	 12	ROHKS VDNCZ	 12

8. MONOCULAR NEAR—LARGE*

(Omit if score on Dial 7)

Line	Right eye	Score	Left eye	Score
1	NCV	 400	DSK	 400
2	HNRCD	 200	CRSZO	 200
2	VOSZK		NDVHK	
3	NDOCV RSZKH	 100	OKZHS NCVRD	 100
4	VRCNZ OSDHK	 70	RCOVN DHKSZ	 70

CODE ..... CODE .....

9. BINOCULAR NEAR—SMALL*

Line		Score
5	OCVKR ZNSDH	 50
6	ZHOCV NDRKS	 40
7	SDOVK HRNZC	 30
8	DNHKO ZSRVC	 25
9	DSVKH ZNOCR	 20
10	NZHKO RCVDS	 17
11	SNCZO RKVHD	 15
12	DHNVO SCZKR	 12

NS5. BINOCULAR NEAR—LARGE*

(Omit if score on Dial 9)

Line		Score
1	NVC	 400
2	CZHSN	 200
2	DKORV	
3	KSDVO NHZCR	 100
4	VZOCS HRNKD	 70

CODE .....

Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

Scoring Sheets Used for Landolt Ring Charts

HEALTH EXAMINATION SURVEY—II

VISION

LANDOLT RING VISUAL ACUITY TESTS

DISTANCE TESTS* (at 10 feet)

LINE (Code)	RIGHT EYE	SCORE (Check)	LEFT EYE	SCORE	BINOCULAR	SCORE
1	UDLUR	 200	UDLUR	 200	UDLUR	 200
2	RURDL	 100	RURDL	 100	RURDL	 100
3	DLDRL	..... 71.4	DLDRL	..... 71.4	DLDRL	..... 71.4
4	LRDLU	 50	LRDLU	 50	LRDLU	 50
5	URUDL	..... 39.3	URUDL	..... 39.3	URUDL	..... 39.3
6	DUDRL	..... 28.6	DUDRL	..... 28.6	DUDRL	..... 28.6
7	UDRLD	 25	UDRLD	 25	UDRLD	 25
8	RULDL	..... 21.4	RULDL	..... 21.4	RULDL	..... 21.4
9	LUDLR	..... 17.9	LUDLR	..... 17.9	LUDLR	..... 17.9
10	ULDRU	..... 14.3	ULDRU	..... 14.3	ULDRU	..... 14.3
11	DURLU	..... 10.7	DURLU	..... 10.7	DURLU	..... 10.7
CODE:			CODE:		CODE:	

NEAR TESTS* (at 14 inches)

LINE (Code)	RIGHT EYE	SCORE (Check)	LEFT EYE	SCORE	BINOCULAR	SCORE
1	RUDLD	 200	RUDLD	 200	RUDLD	 200
2	DLRDR	 160	DLRDR	 160	DLRDR	 160
3	RDURU	 125	RDURU	 125	RDURU	 125
4	UDRUR	 100	UDRUR	 100	UDRUR	 100
5	RLDLU	 80	RLDLU	 80	RLDLU	 80
6	URLUD	 60	URLUD	 60	URLUD	 60
7	LDURD	 50	LDURD	 50	LDURD	 50
8	DRDUL	 40	DRDUL	 40	DRDUL	 40
9	ULUDR	 30	ULUDR	 30	ULUDR	 30
10	DRURL	 25	DRURL	 25	DRURL	 25
11	LDRUD	 20	LDRUD	 20	LDRUD	 20
CODE:			CODE:		CODE:	

** Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.*
*** Retest with diopter (3+) lenses at level reached only those who score 20, 17, 15, or 12 or equivalent (21.4, 17.9, etc.) on regular test. Binocular distance test without regular glasses only.*

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Specifications of Optotype Size, in Snellen Notation, and Number of Optotypes Per Line for Targets Used in the Survey

Snellen ratios for optotype size				Number of optotypes per line			
Master Ortho-rater		Landolt rings		Master Ortho-rater		Landolt rings	
Distance	Near	Distance	Near	Distance	Near	Distance	Near
20/400	13/260	---	---	3	3	---	---
20/200	13/130	10/100	14/140	10	10	5	5
---		10/80	14/112	---	---	5	5
---		10/62.5	14/87.5	---	---	5	5
20/100	13/65	10/50	14/70	10	10	5	5
---		---	14/56	---	---	---	5
20/70	13/45.5	10/35.7	---	10	10	5	---
---			14/42	---	---	---	5
20/50	13/32.5	10/25	14/35	10	10	5	5
20/40	13/26	10/19.65	14/28	10	10	5	5
20/30	13/19.5	10/14.3	14/21	10	10	5	5
20/25	13/16.25	10/12.5	14/17.5	10	10	5	5
20/20	13/13	10/10.7	14/14	10	10	5	5
20/17	13/11.05	10/8.95	---	10	10	5	---
20/15	13/9.75	10/7.65	---	10	10	5	---
20/12	13/7.8	10/5.35	---	10	10	5	---

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